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**NEW ENGLAND SUPPLIERS INSTITUTE
Final Alternate Deployment Pilot Project Report**

NESI, Inc.
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This technical report has been reviewed and is approved for publication.

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13. ABSTRACT This Technology Reinvestment Program (TRP) program significantly contributed to the Air Force's knowledge base concerning customer-supplier relationships. The program developed, supported, and ran many successful workshops for small and medium suppliers in the New England region. These workshops contributed greatly to the bottom line of many New England suppliers. Many of the workshop and seminar participants, with guidance and support from NESI assets, went on to implement advanced purchasing and manufacturing practices. Starting as a part of a quasi-public organization (Corporation for Business, Work, and Learning), this TRP is currently a stand-alone commercial venture and heavily involved with several industry, regional, and national partners.		
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Table of Contents

1. Executive Summary	1
2. Background	3
3. Mission	4
4. Organizational Structure and Governance	6
5. Program Design, Delivery, and Accomplishments	7
• Design and Delivery Principles and Values	7
• Marketing Strategy and Service Paths	9
• Membership	13
• Consultant Evaluation, Selection, and Business Relationships	14
• Workshop Development	15
• Workshop Deployment	16
• Conference Development	19
• Conference Deployment	19
• Implementation Project Design	20
• Implementation Project Deployment	20
• Supply Chain Management Tool Development	24
6. Lessons Learned	32
• Starting-up a Government Invested Organization	32
• Improving SME Performance	38
• Organizational Development and Sustainment	46
7. Recommendations for Future Support for SME Performance Improvement	51
8. Appendices	56
• Steering Committee Members	56
• Bibliography	57
• Glossary of Acronyms and Other Terms	58

1. Executive Summary

The New England Suppliers Institute (NESI) is an Alternate Deployment Pilot Project funded under the Technology Reinvestment Program of the Federal government. It is administered by Air Force Manufacturing Technology (ManTech) at Wright Patterson Air Force Base, OH. The Corporation for Business, Work, and Learning, Boston, MA, is the host organization.

During the four year life of NESI, the project developed a focus on: (1) building awareness and implementation of lean manufacturing practices among small- and medium- sized manufacturers (Small and Medium Enterprise or SME), and (2) the development of supply chain management system models and practices for medium and larger manufacturers. These two content areas rest within a context of the customer-supplier relationship and occupy a central place in the success of both the customer and supplier. This inter-company relationship drives key aspects of the internal organization and methods of both customer and supplier.

Driven by the participation of a number of larger manufacturing firms, that were implementing lean manufacturing practices, NESI developed awareness and implementation tools to support SME adoption of lean manufacturing practices in their supply bases.

This resulted in 38 workshops on lean manufacturing topics (out of a total of 78) presented throughout New England and attended by more than 950 people from over 350 companies. In addition, numerous presentations on lean manufacturing were made throughout the region to manufacturers and manufacturing professional organizations. Many visits between companies were arranged for the purpose of sharing lean manufacturing experiences and learning about both implementation and business results. NESI was directly involved in 16 lean manufacturing implementation projects in companies ranging in size from 16 employees to over 3,000 employees. These projects typically resulted in 50% or larger reductions in manufacturing lead times, cycle times, set-up times, and material movement within three to six months.

NESI's role throughout the awareness-building work was to create a market for lean manufacturing implementation among the region's SMEs. An important component of NESI's competence was its capacity to approach companies from a sound base of knowledge about lean practices. This made NESI staff active partners with companies in defining the correct approach to lean implementation, not just a broker of public funding or a referral source to third party consultants.

During this work on building awareness and readiness for lean implementation, NESI learned the importance of building a strong business case to support senior managers and owners in the decision-making process. Lean practices require a very real and fundamental change in thinking and approach to manufacturing organization and methods, therefore, the "paradigm shift" is neither easy nor linear. In fact, NESI learned that this step of winning over senior management and ownership to lean thinking is the most difficult step. NESI was able to combine the technical knowledge of lean practices with a keen sense of business fundamentals to create a very credible resource for SMEs.

Another key insight for NESI is that, in customer-supplier relationships, the customer's competence as a "customer" is a central factor in the overall success of these relationships and in the effectiveness of any customer's overall supply base. This insight lead to the development of innovative new business development models and tools to help manufacturing firms develop a coherent, integrated business system to manage and work with suppliers. Building on the high-performance characteristics of the Malcolm Baldrige National Quality Award Criteria and a sound connection to the overall strategic needs of the firm, NESI's new supply chain management system business models and implementation tools are beginning to help manufacturers convert their traditional purchasing function into a team-based, cross-functional supply chain management system. This system integrates the company's resources in purchasing, materials planning, quality, engineering, and operations to manage and work with suppliers. Although NESI's work on supply chain management systems has proven to be ahead of the thinking of most managers and companies, there is strong continued interest and implementation projects are now developing.

NESI's Steering Committee, predominantly composed of manufacturing managers and owners, played an important role in focusing the program. They provided continuous critical feedback to the staff as well as very practical direct contributions to its success. The active participation of the Steering Committee added greatly to NESI's credibility. The manufacturing community responded positively to the obvious direction the Steering Committee provided. NESI staff were never mistaken for people from a government agency. And, in a different manner, the sustained participation of the Steering Committee gave the NESI staff significant credibility with NESI's host organization, Air Force ManTech, and other government stakeholders. There was never a doubt that NESI was an "industry-driven" program.

At the outset, NESI was envisioned to include a large component of collaboration among state-based resources for the delivery of services, especially in the area of training. Experience has shown that in New England there are virtually no technically qualified state-based resources in the areas of lean manufacturing and supply chain management. Furthermore, the regional character of the project also posed conflicts for state-based programs in coordinating work throughout the region across the political boundaries of the six New England states.

Given the target audience of SMEs, a broad geography, and objectives that require a long and complex sales cycle, a program like NESI, particularly the portion focused on lean implementation, is not sustainable without government support to offset a portion of the costs. Looking to the future, a number of recommendations for the support of the spread of lean manufacturing and supply chain management can be made as a result of the project.

First, there is an ongoing need for awareness-building for lean manufacturing and its benefits for SMEs. There are 27,000 manufacturing firms in New England, for instance, and only approximately 2% have had personnel attend an introductory workshop on lean manufacturing. Within the context of the aerospace industry, the large OEMs are now developing plans to assess and work with their key suppliers towards lean manufacturing implementation, but there will remain several thousand suppliers who are beyond the resources of the aerospace OEMs. Given the impact of implementing lean

manufacturing on the competitiveness of firms and their customers, it is important that ongoing awareness and skill-building opportunities be provided. This is a gap that otherwise will only be filled in a haphazard manner.

Second, as gains are made by improving shop floor manufacturing effectiveness, the opportunities to make order-of-magnitude improvements through supply chain performance are becoming clearer. However, this work inevitably leads to two issues.

Before substantial work can be done on supply chain performance, the internal business systems of the customer manufacturers in the customer-supplier relationships must be significantly improved so that the customer can provide a well-integrated cross-functional team to manage and work with suppliers. This first issue, the development of the customer's internal supply chain management system, is a crucial precursor to reaping the opportunities of supply chain improvements.

The second issue is the development of robust business and partnering models that will provide both the customer and key suppliers with a mutual environment in which they can make the required investments of financial, human, and technical resources.

2. Background

In July of 1992, a group of large and small manufacturers as well as government representatives held at a meeting in Gloucester, Massachusetts, organized by Bay State Skills Corporation to discuss how they could preserve the region's faltering manufacturing industry. After a recession in New England that eliminated several hundred thousand manufacturing jobs, there was a concern as to whether the manufacturing base could be preserved and revitalized. Many large companies had undergone downsizing, were focussing on core competencies, and were outsourcing much more work to suppliers that they had formerly done in-house. This obviously afforded suppliers with a big opportunity, but were New England suppliers capable of meeting their customers' requirements and adequately performing this work, or would the larger manufacturers need to resort to finding suppliers elsewhere in the country or the world? The New England Suppliers Institute (NESI) was founded to address the issue of making regional suppliers capable and preferred sources for the larger manufacturers. The founders envisioned an organization where industry, government, and educational partners would work collaboratively to improve the capabilities of the New England supply base. This final report details the evolution of NESI from those early days in Gloucester to the organization it has become today. Throughout its course, the reality of market and business conditions have changed NESI, but, it has remained cognizant of its original purpose, even if that purpose has been served in ways not anticipated by its industry and government founders.

Initially, committees were formed of government, education, and industry representatives. These committees addressed issues such as best practices, supplier certification, partnering, and mentoring. By 1993, NESI received a small amount of money from the U.S. Department of Labor to fund a pilot program of mentoring and

supplier development. Some of those projects were not very successful due to inadequate mentoring, poor project specification, or lack of commitment by the companies participating. However, several were quite successful. The successful projects were in lean manufacturing and involved both the customer and supplier in the project. In August of 1994, the Technology Reinvestment Program (TRP) money officially launched NESI as an Alternate Deployment Pilot Project, administered and managed by Air Force ManTech at Wright Patterson AFB, Dayton, OH. Many of the original industry founders and the beneficiaries of the lean manufacturing projects continue to participate in and support NESI to this day.

3. Mission

NESI's mission has evolved during its existence. Here are four statements of goals and mission to illustrate this evolution:

3.1. December 1992 - Mission Statement

New England Suppliers Institute (NESI) exists to help manufacturing companies improve the capabilities that they need to meet their customer's requirements in order to become more competitive. Through a collaborative program between government, private industry, and the educational sectors, NESI will help identify and support efficient access to the education, training, and technical services that companies need to achieve success in quality business relationships, continuous improvement, and the development of company-wide workforce and management skills.

3.2. TRP Proposal and December 1994 Operating Plan

Institute Mission: The New England Suppliers Institute exists to help manufacturing-related companies in New England acquire the skills and abilities they need to meet their customers' requirements in order to become more competitive. Through a collaborative program between government, private industry, and the educational sectors the Institute will help identify and support efficient access to the education, training and technical services companies need to achieve success in quality business relationships, continuous improvement, supplier certification and in developing company-wide workforce and management skills.

Vision: We will achieve our mission when a supplier can readily understand its customers' requirements, has the tools to assess its capabilities to meet those requirements and understands how to get help from customers and from other services.

3.3. 1995 "Goal" statement

Create customer-supplier partnering alliances and tools to foster powerful and profitable partnerships that will benefit large and small manufacturing companies.

3.4. 1996 Mission Statement

New England Suppliers Institute (NESI) was founded by a group of large and small manufacturing companies with the support of education and government partners:
to help improve customer-supplier relations
to improve communications of requirements between customers and suppliers
to help smaller firms meet their customer's requirements

3.5. 1997-1998 Mission and Vision Statement

1997-1998 Mission Statement

We are a New England-based not-for-profit organization that enables suppliers and their customers to achieve excellence in their business relationships. By providing leading edge expertise, innovative tools, and practical techniques to improve cost, quality, and responsiveness, we enhance the manufacturing base in New England.

1997-1998 Vision Statement

We are the leader in the development and implementation of creative solutions that optimize the business contributions between suppliers and customers.

3.6. Discussion of Changes in Mission and Vision

The initial vision and mission set for NESI by its founders, and expressed clearly in the TRP funding proposal, called for the creation of a regional consortium of government and educational institutions that would support "customer-approved" sets of developmental and improvement tools for small- and medium-sized manufacturers. As the project developed through the end of 1995, the mission changed to a far more targeted notion of the highest impact improvements suppliers could undertake, represented by the practices of lean manufacturing¹. Added to this focus on lean implementation was a profoundly new vision of the role of the customer company, namely the urgent need for customers to develop their own internal capacity—the

¹ Throughout this report the terms "lean", "lean enterprise" "lean manufacturing" and "lean manufacturing practices and methods" will be used to refer to a body of business concepts and processes that have evolved over the last twenty years in the US. These concepts and practices are built largely on the work of Toyota, currently embodied as the Toyota Production System. A central American contribution that NESI and manufacturers throughout New England have begun to integrate into "lean thinking" is the work of Eliyahu Goldratt on the Theory of Constraints. Lean has become less identified as a purely shop-floor body of knowledge and is now more broadly seen as applying to the extended enterprise encompassing the entire supply chain from raw materials to the end customer. Thus, lean includes practices like Just In Time Manufacturing (JIT), Demand Flow Technology (DFT), Synchronous Flow Manufacturing, and Continuous Improvement to mention a few of the important subordinate terms. For readers unfamiliar with lean please refer to the Selected Bibliography and the citations for Goldratt, Suzuki, and Womack.

supply chain management system²—so that they could coherently manage and work with their suppliers.

4. Organizational Structure, Staff, and Governance

Note: At the time of this report, organizational changes are underway that will result in the relocation of Massachusetts Manufacturing Partnership (MMP) and Bay State Manufacturing Networks (BSMN) to a state agency, the Massachusetts Office of Business Development.

However, the report is written to reflect the organizational status and environment within which NESI developed and functioned over the life of the pilot project. Thus, reference will be made throughout to the presence of MMP and BSMN as part of NESI's operating environment.

NESI is a program housed within the host organization, the Corporation for Business, Work, and Learning (CBWL), located in Boston, MA. CBWL is a quasi-public corporation chartered by the Commonwealth of Massachusetts to deliver training and career services to unemployed, disadvantaged, and dislocated workers; to develop components working in the areas of youth education and school-to-work transition; and to provide services to small- to mid-sized manufacturers in the form of financial assistance and technical support. NESI is part of the Manufacturing Services Division of CBWL. This division also includes the Massachusetts Manufacturing Partnership (MMP), a NIST-affiliated manufacturing extension partnership office and Bay State Manufacturing Networks, a state-funded network development program. Within this framework, NESI Director Sherry Gordon reports to Fred Ritzau, Vice President of Manufacturing Services and Director of MMP.

The NESI staff consists of three full-time staff members at the Boston office. Sherry Gordon has been the Director of the program from its funded inception under the TRP ADPP funding. As Director, Sherry Gordon is responsible for overall program direction, funder and host organization relations, and primary outreach to partner organizations and resources as well providing services to clients. Mark Orton is the Assistant Director. The Assistant Director's primary responsibilities are product and service development, client outreach and client project development, as well as support to the Director as required. Kim Zminkowski is the program's Administrative Assistant. She is in charge of administration, workshop and conference logistics, marketing and promotion of events, NESI's website, and other operational matters.

² Supply Chain Management (SCM) is the set of business systems and practices that a company uses to manage and work with its supply chain. Throughout this document we will use SCM and SBM as interchangeable terminology. SCM as a business concept and term has superseded Supply Base Management (SBM) which has a slightly narrower focus on only the supply components of a company's supply chain.

One part-time NESI field staff person, Pat Wiggett, NESI Vermont Director, shared with the Vermont Manufacturing Extension Center (NIST MEP center) is located in Burlington, Vermont. Carl Lind, a part-time contract consultant provides outreach and program coverage in New Hampshire and Maine. During earlier phases of the program part-time staff was dedicated to Maine, New Hampshire and Connecticut. The primary responsibilities of the field staff are to provide local client contact and project development services to NESI clients as well as perform market outreach by attending local professional and business organization meetings.

The NESI Steering Committee, which pre-dates the pilot program, is predominantly composed of representatives of the manufacturing community in New England. *See Appendix 8.1* for a list of current and former members and their affiliations. The Steering Committee provides NESI staff with programmatic direction and advice. It meets on a quarterly basis or more frequently as required.

5. Program Design, Delivery, and Accomplishments

Please review *Section 6 Lessons Learned* for comments about other approaches that were used during early phase of the pilot project, but do not remain in use.

5.1. Design and Delivery Principles and Values

5.1.1. Initial Phase

Initial program development was very directly driven and facilitated by NESI Steering Committee member companies, both large and small. A program model was quickly developed and included the following concepts:

- Strong connections were drawn between workshop content and basic business objectives in sales, market responsiveness, quality, and total cost. The building of a business case for improvement provided both an internal sales approach to win support within the company and a value-driven method for selecting improvement projects that would produce significant business results.
- Most of the workshops dealt with large changes in fundamental approaches to a company's organization and work methods and a real emphasis was placed on confronting these "paradigm shift" issues head-on. This included providing clear and practical examples of how companies had incrementally implemented and worked through the changes required to produce significant improvements in business results while performing the ongoing work of the firm.
- Customer-supplier partnering through invitation and participation provided an opportunity for larger customer companies to invite suppliers to workshops. This demonstrated the customer's interest in the supplier and provided a clear message to the supplier that the workshop content was important.

- Wherever possible NESI used real company testimonial about improvement activities. This gave participants role models and an opportunity to question peer companies about how improvement projects actually worked and what business results had been achieved.
- Adult learning models of learning were employed that provided hands-on, interactive exercises and group activities with concepts and workshop materials.
- Every workshop was designed and delivered in a manner that provided concrete outcomes for the participants. Practical skills and next steps were emphasized so that participants could take action with what they had learned.
- The regional marketing outreach provided a broad audience for the workshops and increased opportunities for participants to establish new networking connections at both the individual and company level.

Lead by the Steering Committee, early NESI workshops and projects focused entirely on the issues of implementing lean manufacturing practices in small firms, especially small job-shop suppliers. Particularly among these latter suppliers, there was significant resistance to adopting new practices. Lean was viewed as another “flavor-of-the-day” management fad that was clearly focused on repetitive manufacturing and not suitable for the job-shop environment.

Meanwhile, the larger companies were already implementing lean manufacturing practices and had already come to understand that the success of these internal changes was very heavily dependent on the ability of their suppliers to meet the new requirements for a closely synchronized supply chain. The challenge from the perspective of the larger customer manufacturers was, “how do I make my suppliers lean?”

By the beginning of 1996 the NESI’s workshop offerings narrowed significantly. Two tracks had evolved, Lean Practices and Supply Chain Management. Other topics, such as, *Introduction to Bar Coding, Electronic Data Interchange and Electronic Commerce* that fell outside of these tracks disappeared from the regular offerings.

5.1.2. Mature Phase

As the project came to maturity, an overall vision of highest value business methods and change theory emerged. This vision has guided project developments to date.

We have come to see clearly that lean manufacturing methods, and more broadly lean enterprise methods, including supply chain management, are a key ingredient to companies achieving order-of-magnitude improvements in their performance³. However, the implementation of these practices is a complex,

³ Although there were many in the New England manufacturing community in 1994 who doubted the merits of lean manufacturing methods, today many manufacturers have grasped the lessons. Their questions now relate to how to implement, not why.

multi-phase process. The understanding and commitment by senior management to lead and support the change process must be combined with the development of a clear relationship between organizational change and lean practices and the company's strategic market and customer driven needs. Building on this base, the company can engage specific lean manufacturing (e.g., flow manufacturing) or lean enterprise practices (e.g., supply chain management) while simultaneously developing the culture and organizational infrastructure to build team-based, cross-functional work systems. Within this vision, traditional training approaches for awareness and skill development of the workforce become integrated into the overall project of transforming the company.

NESI's role in this transformation process is providing companies with multiple opportunities for gaining awareness of lean principles, practices, and implementation paths. This is achieved primarily through the public workshops. In addition, NESI provides access to high quality consulting resources to support implementation once the awareness of lean has matured to a need to make the real changes on the shop floor and throughout the organization.

The change model that has emerged from this work has five steps:

Step 1 – Creating Lean Awareness in Senior Management/Owners: This is achieved by a mix of effects from public workshops, role models, customer pressure, and peer pressure.

Step 2 – Broadening Awareness Among Key Company Personnel: This has typically occurred through attendance at public workshops and on-site customized workshops. Senior management is now committed to building the necessary awareness in the company.

Step 3 – Scope and Define Pilot Implementation Project: This is a joint effort by NESI staff and consultants that includes a brief on-site meeting, data collection, and proposal development with the company.

Step 4 – Implementation: Using the support and guidance of the consultant the project is carried out by cross-functional teams of company personnel.

Step 5 – Broaden and Sustain Lean Practices Implementation: This is typically carried on by the company itself with few additional consulting inputs required.

5.2. Marketing Strategy and Service Paths

NESI has employed diverse approaches to reaching its target market. These include:

- Direct mail and fax
- Newsletters, brochures and other printed materials
- Internet world wide web presence
- Partnering with compatible organizations
- Telemarketing

- Public presentations and appearances before professional and industry sector trade groups
- Public workshops

5.2.1. Direct Mail and Fax

NESI purchased several manufacturing mail databases, most notably CorpTech and Harris. Today, the NESI integrated customer/member/event management system contains over 15,000 individual names from 10,700 companies throughout New England. For many larger firms, personnel from all key functional areas are listed. In addition, all attendees at NESI events and those who inquire by e-mail, telephone, or fax are included. Mailings of workshop brochures targeted by function and geography are used to support the workshop and conference schedule. Approximately four to five thousand brochures are mailed for each event to people within approximately 90 miles of the event site. During the life of the project approximately 300,000 brochures or other mailings were sent to New England manufacturers.

When these direct mailings have not produced an adequate attendance response, automated faxes are used to remind companies of the workshops.

5.2.2. Newsletters, Brochures, and Other Printed Materials

To promote the work of the project and to increase awareness and understanding of good practices in customer-supplier relations and lean manufacturing NESI developed a range of written materials.

ConnectionS, a quarterly newsletter, started publication in the summer of 1995 and has continued regularly. This newsletter, typically 6 to 8 pages long, provides a regular update to member companies and other stakeholders about project developments, success stories, workshops, and brief technical discussions. Its content focuses on NESI's practical work with companies and provides another means to build awareness that lean manufacturing and SCM are significant and accessible to small- and medium-sized firms.

Workshop and conference brochures were developed to promote these activities. These presented NESI with a consistent, attractive market image.

NESI also authored articles and provided material for trade and professional publications. Sherry Gordon wrote "Changing The Structure of Business" for *APICS – The Performance Advantage*. Other articles on NESI projects and work appeared in *Purchasing* and *Target* magazines.

5.2.3. Internet World Wide Web – www.nesi.org

NESI's web site has become increasingly more complex and information rich since its inception during 1995. It offers a complete listing of all workshops and conferences with descriptions and agendas readily available. Online workshop registration and credit card transaction are now available. Additional information in the form of downloadable materials on supply chain management, copies of the

newsletter, *ConnectionS*, and other materials are regularly updated. A bibliography of selected material on lean manufacturing and supply chain management is available with immediate access to the internet-based bookstore Amazon.com.

5.2.4. Telemarketing

Telemarketing is occasionally used to increase attendance at workshops. In addition, a telemarketing campaign was employed to market the product launch of the *SCMI Process*. For results of this latter effort see the discussion of SCMI below.

5.2.5. Public Workshops

The public workshops are a key element in marketing NESI to companies. With few exceptions, NESI's implementation projects all resulted from contacts made at and during public workshops. These events provide companies with a good introduction to NESI's approach and establishes early credibility. Every workshop includes a brief (five minutes maximum) introduction to NESI and opportunities for participants to talk with NESI staff during breaks and lunch. In addition role model companies participated frequently in person or via speakerphone. Finally, continuing education credits⁴ enhanced the value to participants interested in building or maintaining professional accreditations.

5.2.6. Public Presentations

NESI staff made over 50 public presentations during the project. Most were given to professional or industry groups and offered a technical discussion of some aspect of lean manufacturing or supply chain management. These forums included local and regional chapters of American Society of Quality, American Production and Inventory Control Society, National Association of Purchasing Managers, and the National Tooling and Machining Association. Wherever possible, the presentations featured content focused on lean manufacturing and supply chain management principles and practices in addition to an introduction of NESI as an organization and service provider.

Table 5.1 Public Presentations

Event	Date
Maine Manufacturing Trade Show – Portland, ME	11/94

⁴ NAPM, APICS, ASQ and other organizations certify professionals through certification programs. NESI workshops provide continuing education credits towards achieving or maintaining these professional accreditations.

Table 5.1 Public Presentations

Event	Date
TQMBASE Council – Bedford, MA	12/94
Manufacturing Quality Alliance – Danvers, MA	12/94
New Hampshire Governor's Technology Partnership – Concord, NH	1/95
Boston ASQC Conference – trade show booth – Waltham, MA	3/95
TQMBASE Council Education Committee – Andover, MA	3/95
Procurement Trade Show '95 – Nashua, NH	4/95
Economic Conversion Group – Lowell, MA	4/95
Rhode Island Manufacturing Support Providers Conference	4/95
APICS	4/95
MA Community Colleges Centers for Business & Industry Directors Meeting - Worcester	6/95
Manufacturers' Roundtable – Haverhill, MA	6/95
Environmental Business Tradeshow – Portland, ME	6/95
Manufacturers' Roundtable – Pittsfield, MA	9/95
New Hampshire International Trade Association – Portsmouth, NH	9/95
Maine Manufacturers Governor's Conference	12/95
BASE Council – Bedford, MA	6/96
APICS Downeast Chapter	8/96
NAPM – VT chapter – one hour workshop	9/96
Manufacturing Quality Alliance, Ward Hill, MA	10/96
ASQC Northeast Regional Conference - 4 hour workshop – Hartford, CT	10/96
Raytheon Supplier Day, Tewksbury, MA	12/96
Boston Area Semiconductor Equipment Council – Bedford, MA	3/97
Purchasing Management Association of Boston – workshop at monthly meeting – Waltham, MA	3/97

Table 5.1 Public Presentations	
Event	Date
Modernization Forum Annual Conference – one hour workshop and one hour panel discussion – Kansas City, MO	4/97
Maine EDI Conference, Portland, ME	5/97
Electronic Industries Forum Supply Chain Summit – Boston, MA – 2 hour workshop	5/97
Attleboro-Providence Jewelry Industry Association – Attleboro, MA	7/97
Toxic Use Reduction Institute Conference – Boston MA	11/97
OSRAM Sylvania Supplier Day - Hillsboro, NH	11/97
Defense Manufacturing Conference - Palm Springs, CA Presentation and Poster Session	12/97
MKS Instruments – N. Andover	5/98
BASE Council – Andover, MA	5/98
Boston Tooling & Machining Association – Burlington, MA	5/98
SPACE – Ludlow, MA	6/98

5.2.7. Other public and private outreach

NESI held a New England regional kick-off meeting on April 4, 1995. This event was attended by over 85 people from throughout New England. George Sarney, President of the Foxboro Company gave the keynote speech. Breakout sessions were held eliciting the companies key issues in the area of customer-supplier partnering.

Individual state kick-off and informational events were also held in June of 1995 in Nashua, New Hampshire and Randolph Center, Vermont. In 1996 kick-off informational meetings were held in February in St. Johnsbury, Vermont, in August in Bennington, Vermont, and in December in Portland, Maine.

5.3. Membership

Company membership in NESI was an initial strategy to develop interest and sustain the connection between NESI and manufacturers. At the outset, membership was envisioned to provide a broad range of services, including access to evaluation and assessment tools, a resource book with a large array of information relating to

customer-supplier topics, networking and benchmarking opportunities, and discounted attendance at NESI workshops. As the project matured many of these services (e.g. the resource book and assessment tools) proved in practice to be of peripheral interest to NESI member companies. And, staff resource constraints also demanded a shift of resources. No clear sustained focus was brought to developing a new and higher-value set of services for member companies. In the end, membership came to chiefly mean access to discounts for attendance at NESI workshops and other events. **Table 5.2 Annual Company Membership Fees** and **Table 5.3 NESI Membership** present data on membership fees and a two year review of membership and demographics.

Table 5.2 Annual Company Membership Fees	
1 – 50 employees:	\$50.00
51 – 150 employees:	\$100.00
151 – 499 employees:	\$250.00
>500 employees:	\$500.00

Table 5.3 NESI Membership						
	Total Member Companies	# of employees				
		<20	20 – 99	100 – 249	250 – 499	>500
Period Ending 7/30/97	119	13	75	20	4	7
Period Ending 7/30/98	117	9	72	22	8	6

5.4. Consultant Evaluation, Selection, and Business Relationships

From the outset NESI staff recognized that external consulting resources would be required to fulfill NESI's mission. Staff members continuously sought new consulting resources. Active searches were conducted through networking and, on occasion, advertisements in newspaper employment classified sections. As the program matured, consulting organizations came to seek out opportunities to work with NESI, thus providing a new source of potential consulting resources.

Considerable energy was devoted to the process for selection and evaluation of consulting resources. Potential consultants were interviewed on the telephone extensively and frequently by more than one staff person. Reference checks with recent clients were performed. Where feasible, client site visits were made. When the consultant was expected to be a workshop leader, opportunities were created for live presentations to NESI staff.

As workshops and implementation work was performed by consultants, evaluation was done continuously by NESI staff and the results shared with the consultants. Participants in the workshops were required to complete an evaluation questionnaire. The results of these questionnaires were tabulated and analyzed. Where appropriate, the content, methods and materials of the workshops were changed to respond to the feedback from the participants. NESI staff monitored performance and obtained feedback from client companies during and at the end of implementation project work. On some occasions, consultants were dropped from further participation in NESI workshops and projects because they failed to respond adequately to customer inputs.

Since all workshops were conducted with the explicit goal of developing implementation projects, client management processes were developed. This defined all attendees at workshops or other events as NESI clients (as opposed to clients of the third party consultant presenter). Inquiries for consulting engagements were scoped and developed with NESI staff participation and involvement. The consultants worked as sub-contractors to NESI for these projects. This meant that NESI maintained oversight and administrative control. NESI invoiced and collected monies due from clients. See *5.69 Implementation Project Design* and *6.1.7 Pricing Philosophy and Practice* for further discussion of the business relationships between NESI and consultants.

5.5. Workshop Development

Based on Steering Committee direction, market reactions to existing workshop offerings, and NESI staff inputs, a working list of potential new workshop topics was developed and maintained. Workshop development was largely accomplished through the use and adaptation of consultants' existing workshop material. This provided NESI with ready access to proven content and pedagogical approaches. This also avoided unnecessary and costly development costs. In some cases workshops were jointly developed by consultants and NESI staff.

And finally, NESI staff, working with training and curriculum development consultants, developed two workshops from the ground up to meet both special requirements in the area of supply chain management and the desire to build more internal training capacity.

5.5.1. Workshop - Are You Ready to Manage Your Suppliers?

This half-day workshop was developed to introduce the concepts of Supply Chain Management. The workshop is targeted at personnel from quality, purchasing, materials, manufacturing engineering, and design engineering functions as well as

senior management. It uses interactive exercises, case studies, and lecture methods.

5.5.2. Workshop – Improving Your Supply Chain Management System – featuring the Beer Game

This full-day workshop introduces the concepts of systems and process thinking through both lecture and a simulation, The Beer Game. Building on this, the workshop continues to explore the concepts and basic practices of an integrated, cross-functional supply chain management system.

5.6. Workshop Deployment

NESI held public⁵ workshops in all six New England states during the project.

Table 5.4 Workshops presents a list of all public workshops and the number of people who attended. Seventy six public workshops had attendance of 1618 people. Average attendance was slightly over 21 persons per event. The vast majority of the workshops were one day in length with a small number, mostly on-site with a manufacturer hosting, were two-day events.

Table 5.4 Workshops

Date	Workshop Title	Location	Attendance
5/4/95	Improving Material Flow In the Job Shop	Danvers, MA	37
7/25/95	Improving Material Flow In the Assembly Job Shop	Burlington, MA	44
7/26/95	Improving Material Flow In the Machining Job Shop	Burlington, MA	31
8/15/95	SPC	Randolph Center, VT	15
8/18/95	ISO 9000	Concord, NH	15
9/14/95	The Visual Workplace: Productivity Through Simplicity and Order on the Job Shop Floor	Westborough, MA	27
10/10/95	Improving Material Flow In the Machining Job Shop	Windsor Locks, CT	22
10/12/95	Improving Material Flow In the Assembly Job Shop	Nashua, NH	18
11/2/95	Purchasing Practices for Manufacturers	Burlington, VT	7
11/14/95	Purchasing Practices for Manufacturers	Worcester, MA	18
11/16/95	Improving Material Flow In the Machining Job Shop	Nashua, NH	24
11/30/95	SPC	Rutland, VT	12

⁵ Some of these workshops were also held as on-site custom workshops at individual companies

Table 5.4 Workshops

Date	Workshop Title	Location	Attendance
12/6/95	Purchasing Practices for Manufacturers	Danvers, MA	28
12/7/95	Improving Material Flow In the Machining Job Shop	Randolph Center, VT	19
1/18/96	Improving Material Flow In the Assembly Job Shop	Brattleboro, VT	25
1/19/96	Improving Material Flow In the Machining Job Shop	Holyoke, MA	11
1/23/96	Purchasing Practices for Manufacturers	Waterbury, CT	7
1/25/96	The Visual Workplace: Productivity Through Simplicity and Order on the Job Shop Floor	Westborough, MA	17
1/31/96	Purchasing Practices for Manufacturers	Concord, NH	23
2/22/96	Purchasing Practices for Manufacturers	Brattleboro, VT	16
3/6/96	Improving Material Flow in the Machining Job Shop	Laconia, NH	10
3/12/96	The Visual Workplace: Productivity Through Simplicity and Order on the Job Shop Floor	Burlington, VT	37
3/14/96	EDI	Nashua, NH	11
3/19/96	Improving Material Flow In the Machining Job Shop	Lowell, MA	19
3/20/96	Improving Material Flow In the Assembly Job Shop	Mansfield, MA	13
4/3/96	Improving Material Flow In the Assembly Job Shop	White River Junction, VT	10
4/17/96	Bar Coding	Nashua, NH	7
5/8/96	Improving Material Flow In the Machining Job Shop	Nashua, NH	9
5/22/96	Purchasing Practices for Manufacturers	Nashua, NH	12
6/26/96	EDI	Randolph Center, VT	36
7/9/96	Improving Material Flow In the Assembly Job Shop	Burlington, VT	25
7/17/96	EDI	Burlington, VT	6
8/6/96	Bar Coding	Putney, VT	13
9/19/96	The Visual Workplace: Productivity Through Simplicity and Order on the Job Shop Floor	New Britain, CT	44
9/26/96	Improving Material Flow Using Lean Manufacturing	Concord, NH	50
10/7/96	Negotiating for Success	Burlington, VT	16
10/22/96	Tools for Evaluating Supplier Pricing	Marlborough, MA	19
10/29/96	Bar Coding	Nashua, NH	14
10/30/96	Involving Suppliers to Improve Quality and Reduce	Portland, ME	9

Table 5.4 Workshops

Date	Workshop Title	Location	Attendance
	Cost		
11/6/96	Negotiating for Success	Nashua, NH	19
11/13/96	Evaluating Your Suppliers	Burlington, VT	23
11/14/96	Improving Material Flow In the Machining Job Shop	Waltham, MA	19
12/3/96	Involving Suppliers to Improve Quality and Reduce Cost	Lowell, MA	15
12/18/96	Business Systems: Planning, Selection and Implementation	Burlington, VT	15
1/22/97	Improving Material Flow Using Lean Manufacturing	Burlington, VT	30
1/23/97	Evaluating Your Suppliers	Nashua, NH	16
2/13/97	Negotiating for Success	Marlborough, MA	13
2/20/97	The Visual Workplace: Productivity Through Simplicity and Order on the Job Shop Floor (1-day)	Marlborough, MA	18
2/21/97	The Visual Workplace: Productivity Through Simplicity and Order on the Job Shop Floor (2-day)	Marlborough, MA	50
2/26/97	Improving Material Flow Using Lean Manufacturing	Portland, ME	25
3/11/97	Purchasing Practices for Manufacturers	Nashua, NH	6
5/7/97	Purchasing Practices for Manufacturers	Portland, ME	15
5/15/97	Improving Material Flow in the Machining Job Shop	Burlington, VT	13
5/16/97	Improving Material Flow Using Lean Manufacturing	Providence, RI	35
6/18/97	Creating the Visually Ordered Factory	Burlington, VT	26
6/19/97	Improving Material Flow Using Lean Manufacturing	Marlborough, MA	15
9/18/97	Improving Material Flow with Lean Manufacturing	Portland, ME	16
9/23/97	Legal Aspects of Supplier Relationships	Waltham, MA	17
9/24/97	Legal Aspects of Supplier Relationships	Burlington, VT	21
9/25/97	Improving Material Flow with Lean Manufacturing	Nashua, NH	42
10/14/97	Improving Material Flow with Lean Manufacturing	Burlington, VT	23
10/16/97	Creating the Visually Ordered Factory	Portland, ME	20
11/6/97	Creating the Visually Ordered Factory	Providence, RI	57
11/13/97	Negotiating for Manufacturers	Burlington, VT	21
1/20/98	Creating the Visually Ordered Factory	Burlington, VT	13
1/22/98	Supply Chain Management	Chelmsford, MA	24

Table 5.4 Workshops			
Date	Workshop Title	Location	Attendance
2/23/98	Where is My Profit in the Supply Chain?	Waltham, MA	12
2/25/98	Improving Material Flow with Lean Manufacturing	Burlington, VT	17
2/26/98	Customer-driven Pull Signals (Two-day Workshop)	Manchester, NH	34
3/12/98	Are You Ready To Manage Your Suppliers - A Process Improvement Approach	Marlborough, MA	19
3/19/98	Activity-Based Costing and Process Simplification	Burlington, VT	34
3/20/98	Improving Material Flow with Lean Manufacturing	Westborough, MA	17
3/25/98	Creating the Visually Ordered Factory	Nashua, NH	20
4/17/98	Creating World Class Suppliers	Nashua, NH	15
5/1/98	Improving Material Flow with Lean Manufacturing	Warwick, RI	39
5/19/98	Supplier Selection and Evaluation	Nashua, NH	28
		Total Attendance	1618

5.7. Conference Development

NESI has held three annual conferences on Total Cost Reduction. The format, content, marketing, and production were entirely the result of NESI staff work with input from the Steering Committee and other industry stakeholders. All three featured industry practitioners presenting case studies of actual work and best practices. As with other work, considerable effort went into using larger customer firms as sponsors and having them invite suppliers to the conferences. The third conference was sponsored and promoted by *Purchasing* magazine.

5.8. Conference Deployment

Table 5.5 shows the attendance results.

Table 5.5 Conferences									
				# of Employees					
Date	Conference	Location	Total Paid Attendees	<20	20-99	100-249	250-499	>500	Un-classified
4/24/96	Total Cost Reduction Conference	Marlborough, MA	62	1	25	16	2	8	9
4/10/97	Total Cost Reduction Conference	Nashua, NH	105	5	34	16	9	24	17

Table 5.5 Conferences									
				# of Employees					
	II								
4/16/98	Total Cost Reduction Conference '98	Nashua, NH	141	1	61	25	18	33	5

5.9. Implementation Project Design

All NESI projects are built around a specific model of consultant interaction with client companies. Every project is designed to build on existing skills and knowledge at the company. And projects are designed to reflect and support important strategic business needs specific to each company.

A specific objective for every project is that, at project completion, the company must have acquired a working understanding of the principles and tools required to sustain, propagate, and improve the targeted processes. This means that every project includes elements of awareness, skill, and knowledge building for senior management as well as for personnel directly involved in the implementation of the lean practices. The consultant acts in a coaching role providing guidance and wisdom, but the work of the project is performed by company personnel. This assures real ownership of the skills, knowledge, and business results.

Senior management, corporate or functional, must provide ongoing leadership and resources to make projects successful. Regular input and approval for project definition, objectives, and milestones is sought from management. This step is particularly important because the cross-functional teams involved in virtually every NESI project can not flourish and succeed with clear support from management.

In nearly all cases, NESI staff visited potential clients to do an initial survey and establish the focus and scope of the projects. In all cases, the detailed project proposal was developed by the third party or NESI staff consultant actually responsible for the proposed work. This ensured that commitments made by NESI to the client were realistic and achievable in their objectives, approach, and deliverables.

5.10. Implementation Project Deployment

NESI carried out implementation projects with companies ranging in size from 20 employees to more than 1,000 employees. *Table 5.6* provides a list of these projects, the companies, locations, number of employees, and the dollar value of the consulting contract. For purposes of estimating the level of consulting input to support these projects, the dollar value of the contract divided by 1,000 equals the number of

person-days of consulting on site. The contract value does not reflect the investments made by the client through personnel participation and investments in plant and machinery.

Table 5.6 Implementation Projects

Project	Company	Location	Employees	\$ Contract Value
Material Flow Project	Allen-Bradley	Manchester, NH	500	25,000
Scheduling Pull Signals	Cirtronics, Inc.	Milford, NH	110	19,000
Scheduling Pull Signals	Cybex Internatiuonal	Owatonna, MN	200	144,000
Material Flow Project	EHV-Weidman	St. Johnsbury, VT	334	45,000
Material Flow Project	Extrusion Technology	Randolph, MA	62	28,000
Visual Systems	Greene Rubber	Woburn, MA	62	5,000
Supply Base management Improvement Process	Hadco, Inc.	Nashua, Inc.	350	Beta site
Scheduling Pull Signals and Material Flow	Hussey Seating	North Berwick, ME	500	18,000
Lean Skills Training	Kronos, Inc.	Chelmsford, MA	890	18,000
Visual Systems	Lemco Miller Inc	Danvers, MA	45	5,000
Material Flow Project	Maine Machine Products	South Paris, ME	120	39,600
Material Flow Project	Markem Corporation	Keene, NH	1700	24,000
International Sourcing Program	Saloom Furniture	Winchendon, MA	90	7,200
Material Flow Project	SB Electronics	Barre, VT	65	25,000
Visual Systems Project	Trident, Inc.	Brookfield, CT	150	6,000
Supply Base Management Improvement Process	Trident, Inc.	Brookfield, CT	150	Beta Site
Material Flow Project	Trow & Holden Co., Inc.	Barre, VT	20	18,000
Pull System On Site Consulting	Foxboro Co. Pawtucket Blvd	Foxboro, MA	600	7,500

Table 5.6 Implementation Projects				
Project	Company	Location	Employees	\$ Contract Value
and Training	plant			
Pull System On Site Consulting and Training	U.S. Tsubaki, Inc.	Bennington, VT	150	5,000
Supply Base Management Improvement Process	Varian Ion Implant Systems	Gloucester, MA	1200	Beta site
Total Project Fee Value				\$439,300

Here are some sample results for these projects:

Markem Corporation:

- Reduced manufacturing cycle time 50%
- Reduced WIP inventory 50% while maintaining 99% delivery performance
- Reduced space requirements on four product lines 75%
- Reduced worldwide finished goods inventory 25%
- Reduced final assembly lot sizes 70% on four product lines

Extrusion Technology, Inc.:

- Reduced overall lead time 40%
- Reduced inventory 50%
- Improved flexibility and responsiveness to customers

Trow and Holden Company, Inc.:

- Increased sales 30%
- Reduced inventory 30%
- Achieved dramatic improvements in customer service

Greene Rubber, Inc.:

- Reduced material movement from 880 ft. to 440 ft. per order
- Reduced cycle time from 59 minutes to 40 minutes

5.11. Supply Chain Management Tool Development

5.11.1. Concept Formation

Very early in NESI's work with companies, NESI staff became aware that there were very substantial shortcomings in the performance of customer manufacturers toward their suppliers. Clearly many of the problems that suppliers were having in meeting their customers' requirements were caused by the customer failing to provide timely, accurate, and reliable information. Suppliers found it very difficult to obtain complete technical specifications. Communications between the customer and supplier were frequently constrained to a single channel between purchasing and sales functions. Customers frequently knew very little about their suppliers and many had never visited even key suppliers.

As NESI staff and interested industry contacts discussed this, a new focus for NESI began to emerge that would balance the original supplier development focus with a new one calling for the customer to undertake performance improvements. Looking at the customer-supplier relationship and the larger supply chain as a business system, NESI raised the important flag that the customer must have coherent, well integrated cross-functional business systems in place to manage and work with its supply chain⁶.

An industry focus group was held in November 1995 with purchasing, materials, and quality managers from a range of medium and large firms. This half-day session resulted in the development of a "laundry list" of the attributes that these practitioners felt were important for a high-performance supply chain management (SCM) system. It was clear from the focus group input that a key element in this vision was the integration of a wide range of functions within a company to manage and work with suppliers. In addition, the lack of senior management understanding and support for the critical role of the supply base was a key inhibiting factor for the development of any system that sought to move beyond the traditional purchasing functionality. Thus, a key element in the creation of this SCM system vision was a strong business case linking market and financial performance with supply base performance.

5.11.2. The SCMI Process

This early work on SCM systems lead NESI staff to envision an assessment process that companies could use to evaluate their current performance and plan required improvements. It quickly became obvious that the development of a large scale assessment tool could not be undertaken without significant new technical resources in the area of assessment methods.

⁶ NESI began its work in this area using the terminology of "supply base management". This terminology has become passe in the marketplace and NESI has adopted the terminology "supply chain management". Throughout the report the terms "supply base management" and supply chain management" are used interchangeably. NESI does recognize that "supply chain management" refers to a larger metaphor of business and that "supply base management" is a subset of the "chain" metaphor.

A search was carried out to find a consulting organization that could provide the required inputs to developing the assessment process. This resulted in the formation of an informal, yet very significant partnership between NESI and Chadwick Martin Bailey, Inc., (CMB) a Boston-based consulting firm that specializes in assessment and organizational change. CMB made a substantial and sustained investment in helping NESI conceptualize the framework and develop the assessment methodology, the *Supply Chain Management Improvement Process* (SCMI Process). In particular, CMB's President, John Martin provided strong inputs to the development work, building on his experiences as a Malcolm Baldrige National Quality Award Examiner as well as his lengthy work in the field of perceptual measurement.

5.11.3. Introduction to the SCM System Framework

Early in the research and discussion of supply base management it became clear that an inhibiting factor for companies was the lack of an overall business model for the internal systems required to build and develop a supply base. NESI's vision was not for simply an enhanced purchasing function, but rather the development of a fully integrated cross-functional system that involved resources from purchasing, materials, manufacturing engineering, quality, and design engineering, thus, we set out to develop a practical model. This became the Supply Chain Management System Framework.

The SCM System is a fundamental business system that integrates internal company resources to manage and work effectively with external suppliers. The objective is to enhance the company's performance through improved manufacturing capability, market responsiveness, and customer-supplier relationships. The business case for the Framework focuses on the capacity of the SCM System to impact four key operational characteristics: total cost, quality, market responsiveness, and access to technology.

The *SCM Improvement Process*, and the assessment activity underlying it, is based on a functional model. This functional model is a prototype for achieving excellence in SCM practice. It is based on the work of NESI and Chadwick Martin Bailey, in conjunction with a panel of practitioners from multiple industries.

The model, the *SCM System Framework*, comprises several Components, which, for measurement purposes, embody key functions and best practices. As these best practices are easier to understand in their functional/organizational context, a discussion of SCM Components follows.

SCM Components

SCM Leadership

The SCM Leadership Component addresses how, and how effectively, leadership sets the direction, designs, deploys, and improves the SCM System.

SCM Strategy

The SCM Strategy Component considers how, and how effectively, formal statements of a firm's requirements are expressed and communicated for:

- Purchased materials and services
- Appropriate allocation of company resources to support supply chain management operations
- Alignment of these resources with the company's other resources and customer and market strategies

Operational Planning

The Operations Planning Component pertains to how, and how effectively, a firm specifies the objectives, tasks, resources, and measurements needed to guide SCM operations. Topics covered include commodity planning, production and inventory planning, supplier selection, and others.

Business Relationship Management

The Business Relationship Management Component addresses how, and how effectively, a firm ensures a two-way flow of understanding between the company and its suppliers, specifically as it pertains to communicating and negotiating requirements with the supply Chain.

Order-to-Delivery Processes

The Order-to-Delivery Component covers how, and how effectively, a firm directs the flow of products and services from suppliers to the company. This encompasses several linked processes, including order release, receiving, incoming inspection, accounts payable, and internal material handling.

Quality and Performance Management

The Quality and Performance Management Component addresses activities undertaken by a firm and its suppliers to ensure that purchased materials and services meet agreed upon requirements.

Human Resource Management

The Human Resource Management Component considers activities undertaken by a firm to develop personnel with skills, knowledge, and attitudes that support the performance of the SCM system.

The SCM Enablers

SCM Enablers are factors that drive overall performance of the SCM system over time. The SCM Enablers have been carefully conceived and defined to embody behaviors and approaches that allow, encourage, and reinforce a firm's achievement of high performance supply chain management practices.

Enablers are expressed across Components; thus, a given Enabler is reflected by a set of measures that appear in several, if not all, Components. As such, Enablers provide insight from another (orthogonal) view of the SCM practices.

Enablers are posited (based on research, analysis, and reflection on SCM); that is, the presence of Enablers help achieve high performance. High performance is defined here in terms of measurable outcomes, including timeliness of deliveries, responsiveness to market needs, minimization of cost, and quality of procurement.

The SCM Enablers are defined as follows:

Customer-Supplier Focus: Efforts dedicated to ensuring the complete satisfaction of not only the end user or customer for a product, but also that of the suppliers whose parts or assemblies are incorporated into the end customer's order.

Design: The purposeful development of products, processes, systems, and services, resulting in their successful application.

Alignment: A unification of goals throughout the company, and consistency of processes, actions, information, and decisions among company units in support of these goals (from 1996 Malcolm Baldrige criteria).

Participation/Involvement: Inclusion of all stakeholders in decision-making processes to ensure the future or continued success of a product, process, system, or service.

Measurement: Numerical information that quantify (measure) input, output, and performance dimensions of products, processes, and services (from 1996 Malcolm Baldrige criteria).

Periodic Review: Regular assessment of the performance of processes, programs, or systems relative to objectives to support continuous improvement.

5.11.4. Details of the Supply Chain Management Improvement Process

Building on the base of the *SCM System Framework* the *SCMI Process* provides a company with a data-driven approach to assessing current performance compared to a high-performance model and developing a set of prioritized action steps for improving performance.

The *SCMI Process* has the following objectives:

- Provide a business development model for supply chain management systems
- Generate senior management involvement and understanding of supply chain management systems

- Create an understanding of current supply chain management system performance
- Improve the connection between the supply chain management system and the company's manufacturing and market strategies
- Develop actionable priorities for improving the SCM system
- Build and improve the SCM system as a high performance business system

All of these lead to improving the capacity of the company to manage and work with its suppliers to meet objectives in cost, quality, time, and technology.

As the name *SCMI Process* indicates this business improvement methodology is a process that includes a suite of tools organized to provide a disciplined approach to assessing performance and developing appropriate improvement actions.

The *SCM System Framework* is not just a development tool. It is the reference against which the *SCMI Questionnaire* gathers employee evaluations of current system performance. The questionnaire is completed by virtually all the company personnel who have contact with suppliers, from purchasing through design engineering and marketing in the new product development process.

The *SCMI Questionnaire* is composed of a mix of factual questions, evaluation questions using scaled (0-10) answers, and, finally, evaluation questions concerning the overall contributions of the system and its components to company performance. The questions are carefully constructed to be free of "buzz" words or jargon. They are focused on key functional elements, policies and procedures, and values. Based on the statistical analysis of all of the individual responses to the questionnaire's 250 questions, a picture of the company's SCM system performance is developed and actionable, priorities are derived.

To further deepen the understanding of the results of the questionnaire, NESI staff carries out a series of interviews (typically 30-40 minutes in length) with 10-15 company personnel. This provides an opportunity to explore incongruities and gaps in the data.

Working with the company NESI develops its findings into a set of recommendations for action to improve the SCM system. This joint activity increases the understanding by the company of findings of the process and increases the alignment between the recommendations and the company's goals and objectives.

The final step in the SCMI Process is a decision and action meeting with the senior management and other staff of the company. Typically this is a three to four hour session that has the following objectives:

- Learn what supply chain management is and its connections to the company's fundamental business objectives. Review the *SCM System Framework*

- Understand the methodology of the *SCMI Questionnaire* and data analysis
- Review the findings of the study
- Discuss the recommendations for action
- Plan and approve next action steps for implementation

Recommendations range from fundamental steps such as creating a leadership team to very tactical steps like developing the commodity analysis structure or supplier evaluation process. Typically skill development training needs are also identified. Other recommendations touch the fundamental culture of the company. For instance, a lack of cross-functional approach in the current SCM system is usually indicative of a functional approach overall within the company.

Built into the *SCMI Process* is an opportunity for sustaining continuous improvement. The Framework provides a development model to build an SCM system that responds to changing requirements. The *SCMI Questionnaire* provides a data driven approach to employee evaluations and direction for improvement.

5.11.5. Supply Chain Management Pathways

Based on market reactions to the *SCMI Process*, NESI developed a simpler, more flexible assessment and improvement process, *SCM Pathways*. This product, based on the *SCMI Framework*, uses an interview process instead of the questionnaire and database. This is particularly well suited for smaller firms with resource limitations which nevertheless, for strategic reasons, need to develop an enhanced capacity to manage and work with suppliers.

On the other hand, for other larger companies, the gap between their current supply chain management systems or purchasing and materials planning processes and the SCM system described by the *Framework* is very large. Both sets of companies need an improvement strategy that develops basic functional elements of an SCM system with a clear vision of a fully deployed system. For these companies *SCM Pathways* provides a clear approach to developing the infrastructure required to undertake the development of a fully capable SCM system.

The purpose of *SCM Pathways* is to:

- Evaluate business processes and resources that form the basis of a fully functional, integrated SCM system.
- Generate a plan of action to improve performance in these areas.
- Educate senior management and those involved in the supply chain management about the system, key processes, and its relationship to fundamental business performance.

SCM Pathways contains a baseline set of functions and organizational attributes that are required to start companies on the path to developing the high-performance systems characterized by the SCM System Framework. *Pathways* focuses on core functional competencies that are precursors of a supply chain management system and the development of enabling behaviors important to high-performance business systems.

The functional competencies contained in *SCM Pathways* are:

- Commodity planning
- Supplier selection, evaluation, and certification processes
- Information systems
- Measurement systems
- Purchasing and materials systems
- Supplier relations

Embedded in the functional competencies (and elsewhere throughout the organization) are the following enabling behaviors:

- Cross-functional, team-based work
- Multi-skilled work force
- Continuous improvement culture
- Senior management understanding & support

Note that several important functions (e.g., quality and design engineering) are not included as separate items above. Issues and functionalities from these areas impinging on management of suppliers are included within the functional competencies listed.

Assessment and Evaluation Approach

The approach taken here involves a combination of assessment and education. The deliverables focus on actionable, prioritized information.

Using information provided by the client and the results of the assessment processes of the *SCM Pathways*, we can develop clear, prioritized improvement activities for the client. These are set within the context of the client's overall business goals with the objective of improving current performance and developing readiness for an integrated supply chain management system.

The *SCM Pathways* assessment is clearly focused on business systems and processes. Expert assessors combine the Pre-Visit Questionnaire data and the findings of their on-site research and interviews to develop recommended improvement actions.

In order for the company to take full advantage of the recommendations an educational component is included in the final presentation. This focuses on what

a supply chain management system is and its relationship to achieving overall business objectives.

5.11.6. Launching the SCMI Process

Following the beta-testing of the assessment process at Varian Ion Implant Systems, Trident Inc., and Hadco, Inc., efforts were undertaken to market the tools to a broader audience. This included a targeted effort around companies already aware of NESI and specific telemarketing efforts by a contract consultant, Frank Tahmoush, throughout winter and spring of 1997. An article about the process appeared during the summer of 1997 in *Purchasing* magazine.

5.11.7. Market Reaction

Whenever presentations or discussions were held with senior managers at companies with suitable profiles, the reaction to the framework and the assessment process was one of real interest. A powerful business case for SCM was developed. This focused on four business fundamentals: total cost, quality, market responsiveness, and technology. Building on this, many managers understood the importance of SCM at a strategic level and were intrigued generally by the assessment methodology. Nevertheless, selling the *SCMI Process* requires a paradigm shift in several dimensions.

First, since it is based on high-performance, team-based cross-functional work, functional managers in purchasing, materials, quality, and engineering are inhibited or even opposed to the implementation of a new system that challenges their functional domains. This meant that NESI had to sell to the very highest management levels in medium and large organizations.

Second, most senior managers have little strategic understanding of the role of the supply chain in their businesses. Marketing, engineering, and financial expertise dominates in most firms. It is difficult for managers with these backgrounds to envision the larger role that the supply chain has in their focused, flattened organizations.

Third, the *SCMI Process* proved to be simply too large both conceptually and in practice, for any but real visionaries to embrace. There were no convenient entry points into the process that would allow a manager to pilot or test out the concepts and process.

Fourth, the assessment process also required senior managers to understand and accept perceptual measurement techniques. There were also difficulties in differentiating the process from benchmarking.

Despite these problems, NESI staff and other stakeholders continued to feel that NESI had identified a key competitive issue and developed a powerful set of ideas and tools to address the opportunities for manufacturers to develop an integrated supply base management system.

5.11.8. The Current Status of the SCM Tools

Although NESI has experienced trouble in commercializing its SCM tools, the overall vision remains strongly supported by anecdotal information from the marketplace.

As Professor David N. Burt noted at the Defense Manufacturing Conference last year, the real challenge to supply chain management remains the development of the integrated internal capacity for companies to carry out a supply chain strategy.

We are currently developing new market and partnership approaches to selling both *SCMI Process* and *SCM Pathways*.

6. Lessons Learned

6.1. Starting-up a Government Invested Organization

6.1.1. Focus

NESI started the project with a very broad, somewhat diffuse mission. It was difficult to explain to non-industry participants. Even to the industry participants the mission appeared to be more “apple-pie-and-motherhood” than substance. There were no concrete products or services. A large part of the early work was to discover and articulate a practical vision and mission that fit the needs of the project and its stakeholders.

Driven in part by actual industry and market demands and, in part, by the NESI staff understanding that achieving a narrower focus was required to accomplish real practical results, NESI staff launched services that quickly developed a sharp focus on lean manufacturing implementation and supply chain management.

6.1.2. Host organization

Bay State Skills Corporation (BSSC) was the original host organization. As the home of Bay State Manufacturing Networks (BSMN) and Massachusetts Manufacturing Partnership (MMP), BSSC had a substantial focus on the issues and practices of working with manufacturing companies. In addition the organizational culture was supportive of a pilot project like NESI that required some inventiveness and agility to meet emerging needs as the project discovered them.

Following the merger of BSSC with the Industrial Services Program (ISP) to form CBWL during the summer of 1996, the manufacturing oriented programs from BSSC (NESI, MMP, and BSMN) became the Manufacturing Services Division of the newly organized CBWL.

Within both BSSC and CBWL, NESI was the only program or project with a clear regional focus. This posed potential opportunities for both organizations but also presented very real conflicts between NESI's work throughout New England and the narrower focus of the state-based programs that composed the rest of the work of these host organizations.

6.1.3. Regional issues, opportunities

From its initial meetings, NESI worked with a regional perspective. The larger companies involved clearly saw their supply bases to be, at least in part, regional. This meant to them that a large portion of their purchased content was produced within a couple of hours drive. However, they also saw that the emerging globalization of manufacturing required that their regional suppliers improve their competitiveness within this new environment.

6.1.4. Partnering with state organizations

At the outset, NESI had a number of apparent stakeholders within each of the New England states. During the first year of the project a large amount of staff time was devoted to contacting these stakeholders and seeking their participation and financial and in-kind contributions to the project. In each state the points of contact were with different elements of the state government. Frequently the state representatives did not have adequate programmatic connection to NESI's mission. For instance, in New Hampshire, the contacts were at that state's Department of Postsecondary Technical Education and the Department of Resources and Economic Development. Their capacity to understand and participate in a leading edge project involving customer-supplier relations was quite limited. Each state brought its own inherently state-bounded parochialism to a project whose scope was defined by supply chains and economic relations that did not fit within such political boundaries. In an overall political environment in which states perceive themselves to be competing against other states to attract industry, a regional scope created many problems for state funding and participation.

Where states did commit resources to the NESI project, the staff devoted to the project never had adequate business backgrounds in manufacturing practices and management to represent NESI's program and participate in content development. Almost without exception the state resources were workforce development focused. The combined lack of business background and the workforce training focus prevented these resources from understanding the role of organizational change and development as key issues to improving firm performance. They could not envision the crucial developmental connection between business strategy, business organization, and workforce skill requirements.

Frequently, NESI was seen as competition or duplication for existing state industry-oriented programs. Complicating all of this was the emergence of NIST's MEP system. See the discussion of MEP below (7.1.5 Working with the NIST MEP System).

Finally, NESI's scale was too small to attract or support significant political or bureaucratic interest. The costs for NESI staff time to generate this support far exceeded its capacity and the potential financial and in-kind returns.

6.1.5. Partnering with Community and Technical Colleges

During the first year and a half of the project, NESI contacted virtually all of the community and technical colleges in each New England state. Presentations about NESI were made to the directors of organizations within these community and technical colleges with names like "Center for Business and Industry." These typically represent the arm of these institutions whose primary charter is to sell training services to companies. With a few exceptions, the staff and programs of these centers are focused on job specific training, e.g., basic computer skills, computer applications skills, bookkeeping, etc.

With one exception, the community and technical colleges do not have the resources to provide training in the areas of lean manufacturing or SCM. Some do offer basic training in fundamental enabling skills like problem solving, team work, etc. However, given the apparent charter of these institutions, it is not clear how they will, or should, respond to the emerging need for lean manufacturing education.

Northern Essex Community College (NECC), Haverhill, MA is the exception. This school has developed within its Center for Business and Industry an extensive curriculum and capability to support high-performance manufacturing. NECC became the New England site for the Consortium for Supplier Development, a skills development program lead by Motorola, Texas Instruments, Xerox, and others. NECC was a sub-contractor for NESI on one large lean skills development project. They performed extremely well and won the support of the company involved. A limiting factor for NECC, and other community and technical colleges are political limitations on the areas they can serve. This is an inhibiting factor in a regional economy.

6.1.6. Working with the NIST MEP system

Occurring almost simultaneously with the initiation of the NESI pilot project, the National Institute of Standards and Technology (NIST), part of the US Department of Commerce, launched Manufacturing Extension Partnership (MEP) programs in Connecticut, Maine, Massachusetts, New Hampshire, and Vermont. In Massachusetts, the state's MEP statewide office for the Massachusetts Manufacturing Partnership (MMP) was housed at Bay State Skills Corporation (BSSC), also the host organization for NESI.

During the first year of the pilot project when NESI staff was working to establish the envisioned state and regional government and educational partnerships, the simultaneous start up of the MEP system increased the difficulties of attracting and sustaining support for NESI by state policy and administrative leaders. As noted in a preceding section (6.1.4), state staff could not differentiate between the proposed service offerings of the MEP system and

NESI regional approach that featured a customer-supplier relationship that was largely a mystery to them.

In addition, the MEP system came with the promise of long term federal funding. NESI was clearly only a three year pilot project with a much narrower base of federal funds and no political constituency.

The only NESI-MEP relationship that achieved a stable and healthy basis developed in Vermont. Through some coincidences, Muriel Durgin, a former quality manager in several manufacturing firms, worked as NESI Vermont State Director for several months between that state's proposal to NIST and the beginning of funded MEP start up of the Vermont Manufacturing Extension Center (VMEC). Once Ms. Durgin officially began work as Director of VMEC, she assigned Pat Wiggett to be part-time NESI Vermont Director and part-time project manager for VMEC. Beyond the fortunate coincidences and good personnel choices, NESI and VMEC developed a workable definition of programmatic territory and responsibilities. Since NESI had developed some potent workshops, especially in lean manufacturing, there was an immediate opportunity for joint sponsorship of these events. This instantly provided VMEC with visibility in the manufacturing community as a sponsor of highly valued educational events. VMEC project engineers promoted the workshops and attended. This provided them with both valuable exposure to state-of-the-art lean manufacturing knowledge and opportunities to make good contacts with personnel at many Vermont companies in a positive environment.

As implementation projects emerged from the workshops, NESI acted as prime consulting contractor. Only during the last year of the pilot did strains emerge over this division of labor between VMEC and NESI. Partly this was because VMEC came to consider lean manufacturing as one of their focus service areas and the earlier NESI projects were on average much larger in terms of both business impact and dollar volume than VMEC's projects. To date, these obstacles have been addressed through new contracting and revenue sharing procedures. NESI remains the key supplier of workshops for VMEC and shared staffing continues to provide a working bridge between the two organizations and a shared customer base.

To further illustrate the NESI-MEP relationship we can examine MMP.

Although NESI shared organizational and physical space with the MMP statewide office at both BSSC and CBWL, the balkanized structure of MMP⁷ ultimately accentuated the inherent potential competitive issues between NESI

⁷ MMP was composed of a statewide office housed at BSSC / CBWL. This office functioned only as an administrative hub and never developed a service delivery capacity of its own. The five regional offices were each separate non-profit corporations with the full panoply of Boards of Directors, administrative staffs and other local political and educational stakeholders. MMP never developed an effective statewide marketing or programmatic presence. Each of the five offices operated largely on its own. This was particularly noticeable in separate marketing efforts and disparate program and service delivery and development.

and MEP in very unproductive ways. Early during the first pilot program year, NESI Assistant Director Mark Orton⁸ made visits to each of the five regional offices of MMP as well as presentations to several statewide meetings of MMP directors and staff. Although several workshops were co-sponsored by individual MMP regional offices, there was never a statewide effort to market or support the workshops. With a few exceptions, MMP project engineers did not attend NESI workshops either for education or marketing opportunities. As NESI's program became more sharply focused around lean manufacturing and SCM services, most of the MMP offices came to see NESI as a competitor. Although some joint work was attempted around the development of SCM assessment tools, the competitive pressures finally overwhelmed MMP. By the end of the third year of the pilot NESI staff came to clearly see that NESI was in fact a competitor to MMP and working relations largely ceased. Unlike the VMEC case, there was no vehicle to resolve the competitive issues in a unified workable manner. The five different MMP offices with five different, and at the time conflicting, sets of needs made attempts at carving out a resolution of the competitive issues too difficult.

Another key issue in working with the MEP system was the high level of turnover and the poor quality of the management and technical staff in the MEP system. Within the six New England MEPs, none of the original state directors remain. And only Tab Wilkins at ConnSTEP has more than two year's tenure. At the Project Engineer level, the turnover in staffing has also been high. In addition, the leadership of New England's MEPs was not drawn from people with strong manufacturing backgrounds.

Each of the six New England MEP's has a different structure, policies, stakeholders, and service programs. In addition, NIST program objectives and metrics drive behaviors that produce a focus on generating a large number of contacts with manufacturers. This market penetration strategy directs MEP resources towards high incidence activities with low value to the end customer-base. Within the New England MEPs, none have developed a focused service program and attendant internal technical resources to support the focus. They have largely been responding to whatever services are called for and providing brokered third party consulting resources to fill actual project needs. Thus, the MEP organizations are largely assessment and resource brokering operations. It is not currently possible in New England for the MEPs to deploy consistent, high quality services in such fundamental lean manufacturing improvement areas as set-up reduction, pull manufacturing, cell design, and teamwork and problem-solving skills.

These factors made it extremely difficult to build on the regional opportunities that are inherent in the supply chains of the larger OEMs in the region. During year one and into year two, NESI staff repeatedly articulated a

⁸ Mark Orton served as the start-up Director of the Merrimack Valley Manufacturing Partnership (MVMP), one of the five affiliate offices of MMP, from 4/94 through 1/95.

vision of creating working relationships with the large OEMs (e.g., Foboro, Raytheon, Pratt & Whitney, Hamilton Standard) that would create opportunities to develop supplier improvement projects driven by the OEM customer, coordinated by NESI, and implemented by the local MEP organizations.

6.1.7. Pricing philosophy and practices

From NESI's earliest work all workshops and consulting have been provided on a fee for service basis. Given the small size of the overall budget, it was clear that providing highly subsidized services would mean that very few services would be provided to very few companies. In addition, both the staff and Steering Committee felt that companies would not value free services and that one of the significant metrics of success would be the degree to which companies felt that there is a real payback in using NESI services.

A more controversial topic that was repeatedly discussed by both staff and the Steering Committee were the pricing ranges for services. Membership fees were, and are, based on a sliding scale based on the number of employees. Full-day workshop fees were generally set at \$150.00 per person for personnel from NESI member companies and \$200.00 for non-member company personnel. These fees were generally 50% of market rates for similar workshops. During the third and fourth year several experiments were conducted with fees that ranged to \$300 and \$350 per person. There was no discernible difference in the number of attendees from the smaller firms (< 50 employees) who it was thought might be price sensitive. It is the NESI staff observation, supported by some on the Steering Committee, that the controlling issue for smaller firms is time, not cost. Sending even one person off-site for a whole day is felt by many smaller firms to be a large burden. For smaller firms, not already motivated towards training and organizational change, almost any barrier can inhibit participation in workshops and off-site events.

Implementation consulting projects were all offered at market rates. We never found price to be a significant barrier to implementation work because the return on investment for these projects was extremely high.

In some cases, implementation projects were offered to companies on a contingency fee basis. This meant that companies only paid half of the ongoing fees for the projects until specified objectives, typically inventory reduction, were met. This provided the company with a lower entry cost and with the needed additional sense of value and commitment by NESI and the consultant that the project would be successful.

6.1.8. Program Organizational Structure

NESI began the project envisioning an organization with an overall Director and a regional Steering Committee supported by six State Directors and State Steering Committees. Once the difficulties of attracting substantial state funding and participation became apparent and this was coupled with the inability of state community and technical colleges and other state-based organizations to provide training and educational support to the project, the rationale for this state-based

structure evaporated. From the point of view of the industry stakeholders, the political boundaries and their attendant issues of territoriality were costs that only made sense if there was a substantial input from the states to support the project's objectives.

As the project is concluding, NESI has completely abandoned any state-based strategy, except in VT where the strong relationship with VMEC has survived the centripetal forces of state-based programs. Moving into the future, NESI will continue to work with a Steering Committee, but is moving towards staff with real technical skills assigned to geographic territories. This will position NESI to provide more direct consulting using NESI's dedicated resources and improve operating margins.

Future work with community and technical colleges will be market-driven based purely on their competence and capacity to respond to manufacturers' training needs.

6.2. Improving SME performance

NESI began the pilot program with an agenda of performance improvement strategies. Here is a review of actions and findings for some key elements of this original vision. Following that is a discussion of the work carried out during the pilot.

6.2.1. Common Supplier Certification

A significant burden for customer companies is the need to evaluate the performance of their suppliers both as part of the selection process and as part of ongoing improvement efforts. From the supplier perspective, multiple independent evaluations, frequently requiring multi-day site visits, from a number of major customers is a very large organizational burden. Both sides in this customer-supplier issue expressed a desire for a common supplier certification process that would decrease the costs across the board.

NESI staff undertook discussions with industry participants and research among other government-funded programs to evaluate the opportunities and experiences with common supplier certification programs. A close study was made of the work done in Minnesota by Minnesota Technology, Inc. to create a common ("unified") supplier certification process, the *Supplier Qualification Survey*. After several years work including the participation of several large OEMs (e.g., Cray Research, Honeywell, IBM, Reliance Motion Control, Seagate and 3M, among others) it was clear that the project had not achieved real acceptance by both the large OEMs and their suppliers. It was extremely difficult to mediate all the different requirements among the departments of each OEM and across the company boundaries between the participating OEMs. Matching NESI's local experience, the larger customer companies were at very different levels of maturity in their own development as high-performance organizations. This created conflicts in the common supplier certification process between manufacturers with a more traditional audit/inspect approach to quality and those who had moved to process assurance and continuous improvement.

In the end, each OEM found it still necessary to perform certain evaluation processes to assure process capabilities or compliance that were felt to be crucial and idiosyncratic to each OEM.

Based on NESI staff input and Steering Committee discussion, it was decided that this approach to simplifying customer-supplier relations would not bear fruit.

6.2.2. “Customer-Approved” Developmental Improvement Tools

One of the central ideas from the founders of NESI, expressed throughout the funding proposal, called for the development and deployment of customer-approved improvement tools. In this scenario NESI would provide a means for the identification of an improvement pathway and the tools associated. This would lead to a “customer-approved” set of improvement tools. The concept offered the obvious potential for greatly improved economies of scale and inherently great credibility among suppliers. However, as with the discussion of common supplier certification, immediately above, the concept proved impossible to implement. There are simply too many variations in perceived performance requirements for suppliers among even a very small group of larger customers. And the additional variables of differing cultures among both customers and suppliers make this concept unworkable.

It should be noted that NESI has substantially adopted what might be called the “market-approved” improvement tools of lean manufacturing. Although there is some variation in language and packaging, lean manufacturing principles and practices is emerging as a powerful set of “market-approved” improvement tools.

6.2.3. Networking Companies for Group Training and Implementation

For obvious reasons of economy of scale, it is attractive to group companies together for sharing of training events and implementation consulting resources⁹. NESI made several attempts in the first two years to develop just such an approach. The New England Visual Systems Collaborative¹⁰ is a good illustration. Following up on public workshops NESI staff identified a number of companies who expressed interest in collaborating on a group project to implement visual systems. Starting with approximately seven companies within a reasonable geographic proximity (75 miles), three months of staff work visiting and scoping the project with each potential company resulted in a group project containing two

⁹ Here we are discussing the grouping of companies by third party service providers, like NESI, as opposed to the grouping of companies in a supply chain by a customer through devices like supplier associations.

¹⁰ The New England Visual Systems Collaborative project involved five to six day-long work sessions spread out over two to three months. Each member company was expected to host a session. Each session consisted of a 2 – 3 hour training session with the balance of the time spent on shop floor implementation tasks. Videotape and other reporting mechanisms were used to keep all parties up to date on progress at each participating site. The project cost each participating company \$5,000 plus appropriate expenses.

companies. Several others pulled out not more than a couple of days before the launch. There proved to be considerable difficulties in finding companies who were of similar maturity, commitment levels, and readiness to move ahead on a given date.

NESI staff felt that the costs of organizing this collaborative and the relatively small number of companies involved mitigated against further efforts to organize group projects on this ad hoc basis.

More recently, NESI provided technical assistance to Springfield Area Coalition for Excellence (SPACE) in organizing a kaizen blitz event. This has provided experience with working with an organized network of companies. The results are very different. In this case, SPACE, an eight year old geographically-defined membership organization, has a long record of organizing training and other events for manufacturers, service firms and government. The staff of SPACE was easily able to mobilize 7 firms who were willing to commit several people each to a week long kaizen blitz event. The first event produced a sustained demand for six more kaizen blitz events to be carried out at six different host sites with teams from all of the participating companies at each site. The companies have spoken very highly of the value of having outsiders and non-experts work on the teams to bring fresh perspectives and ideas to the problem solving. The companies are paying market rate prices for the consulting support required.

This work with SPACE suggests that networks of companies can be very successful in gaining economies of scale as well as the synergies of group learning. Part of the obvious dynamics shown by the SPACE example is that the staff of SPACE knows their member companies well. There is mutual respect and understanding and a history of working together that made the planning and decision-making meetings brief and effective.

Finally, groups of companies lead by a common customer, are clearly a continuing source of opportunity. Supplier associations¹¹ and other extensions of the Japanese keiretsu models offer new methods for companies to work together.

6.2.4. Leverage of Large Companies with Their Suppliers

It is a commonplace assumption that large companies have a great deal of control over their suppliers. In part, this assumption is driven by what appears to be well-placed common sense that suppliers are very dependent on their large customers and therefore overwhelmingly ready to respond "How high?" when the customer says "Jump." In part, this assumption is also driven by the preponderance of the global automotive industry as a model of industrial organization and performance. This Japanese automotive model and recent American automotive experiences¹²

¹¹ See, for example, Creating World Class Suppliers by Peter Hines in the Bibliography appendix

¹² See The Machine That Changed The World by Womack et al and "How Chrysler Created An American Keiretsu" by Dyer in the Selected Bibliography.

fill an ongoing saga about supplier relations in the business and academic press to the exclusion of customer-supplier relations that NESI has found more typical.

NESI's experience demonstrates that the leverage of large customers over suppliers is in fact substantially more limited than commonplace wisdom suggests. We have seen repeated instances in which suppliers have resisted the efforts of large customers to induce them to change or adopt business practices and technologies.

We have observed the following factors influencing the behavior of suppliers in responding to customer demands:

- Suppliers want to maintain the independence of their businesses. They do not want to be, or feel, captured by large customers. For some suppliers this leads to active sales diversification efforts and policies limiting the maximum share of capacity for any one customer.
- Suppliers receive incomplete, poorly planned, and/or conflicting statements of requirements from a customer.
- Suppliers receive conflicting requirements from different customers. Currently this is very visible in conflicting requirements for expensive CADCAM systems. Suppliers literally do not have the resources to make all customers happy.
- Suppliers perceive "supplier development" and "supply chain optimization" and other such "buzzword" campaigns to be simply a strategy of larger companies to shift costs and liabilities to suppliers.
- Suppliers perceive that in the end they are expendable elements in an increasingly global game of lowest price. Talk about long term partnerships and strategic alliances only extends to the next downturn in quarterly profits.

Large companies who are more successful in their efforts to improve supplier performance, particularly through targeted changes in supplier business practices, do so by addressing these issues directly with sustainable customer-supplier business relationship practices. And, this argues further for NESI's vision that an extremely significant element in the customer's success is developing a strategically motivated, internal system to manage and work with their suppliers.

6.2.5. Improving Supplier Performance Lead by Customer Companies

Here is a summary discussion of supplier development as conducted by customer companies. This section reflects both NESI experience and research on this topic. The bulk of this summary is taken from articles (published and forthcoming) in NESI's newsletter, *ConnectionS*.

Introduction

Improving the performance of the supply base, particularly focused on total cost, quality, market responsiveness, and technology, is an important, indeed,

for many companies, a strategic business objective. This discussion summarizes NESI's observations, research, and work with companies over the past four years. There is no single right answer, no cookie cutter. So, within each phase described here, you will find concepts and approaches that may or may not fit a company's particular need. Discovering and executing the correct ones is in fact a key element of a successful program.

Getting Ready

The foundation for any effort to improve supplier performance is putting your own house in order. NESI's early work in customer-supplier relations brought us quickly to the conclusion that the capacity of the customer to act coherently, reliably, and responsively as a customer to its suppliers is a key factor in the health and productivity of customer-supplier relations. In short, the customer is a potentially important source of failure in the customer-supplier relationship.

The first step to better supplier performance is to recognize that supplier improvement, like almost all significant supply base issues, requires a cross-functional team approach. To succeed, you must organize the company's purchasing, materials, quality, manufacturing engineering, and design engineering resources so that at the right moments in the planning and execution of work with suppliers the right functional skills in the correct mix are available. This will be obvious as you approach working interactively with suppliers on problems that involve the full range of commercial business issues and technical ones in product design and process improvement.

A next step is the development of a strategy that translates the company's overall business plan or strategy into a supply base requirements. An important element is to examine the manufacturing and product development strategies closely so that the supply base supports these strategies in detail.

For instance, if a company is undertaking the implementation of lean manufacturing practices internally, the fast cycle time, small lot sizes that are typical of lean practices will require supplier selection and improvement practices to develop a supply base that can effectively support these requirements.

Or, as another example, new product development may require early supplier involvement and significant technology inputs to achieve fast cycle time and best total cost performance. This will require technology and make/buy strategies that design engineering and other functions support as well as gainsharing relationships with key suppliers to sustain their investments in the product development process.

Thus, strategic business requirements drive different supply base processes and policy decisions.

A good approach to operational planning is a team-based commodity planning process. This provides a platform from which to translate strategy into detailed operational objectives and policies. Commodity planning provides clear

view of who the key suppliers are and why. In many cases, it also reveals opportunities to consolidate and rationalize¹³ the supply base.

Another key step in getting ready is to prepare your company to answer the key suppliers' question, "What's In It For Me?". Partnership is based on trust and, in the end, on a level of assurance, as perceived by suppliers, that there will be a continuing stream of profitable work for their companies. There are a myriad of devices that express a company's partnership commitment to suppliers, from formal strategic partnering agreements, long term contracts, annual blanket purchase orders to mere hand shakes. But, there is no doubt that suppliers will invest their resources only in some reasonable proportion to their perception that a customer will provide them with future business. The correct level of assurance, contractual and otherwise, sustains supplier investment.

Developing and sustaining supplier performance measurements is a sine qua non. As the old saw says, "If you can't measure it, you can't manage (or improve) it." Even seemingly simple metrics like on-time delivery must meet high standards of accuracy, timeliness, and reliability. Sloppy metrics immediately undermine credibility in the eyes of suppliers.

We can not leave this discussion of getting ready without mentioning the role of senior management support and participation. As with many important aspects of a business, regular senior management participation and oversight create the environment within which important initiatives, such as cross-functional teams, are created and sustained. Without this understanding and support, it is unlikely that sufficient resources will be applied to supply chain management be successful.

Approaches to Improving Supplier Performance

Looking at the range of approaches taken by customers to improve supplier performance, one can't help being struck by how many there are and how little well-developed information there is about which supplier improvement practices actually produce results. For our purposes here we will bundle them into three groups. The first of these are the traditional approaches to working with suppliers.

Directive & Compliance

The traditional approaches to improving supplier performance rest on two notions. First, the customer simply tells, or directs, the supplier to undertake some new procedure or to follow a new policy. There is the long tradition of customers sending letters to suppliers announcing some program or another and specifying some date for implementation. This directive approach to inducing suppliers to change a business practice or policy is, at best, marginally productive.

¹³ A common early step in implementing supply chain management is the analysis of the supply base to seek opportunities to concentrate purchases and relations on fewer suppliers. This so-called "rationalization" leads to fewer, higher-valued relationships that should also fit into a longer term view of the strategic supply requirements of the firms.

The second traditional approach to improving supplier performance is to seek compliance by the supplier with some standard set of business practices. ISO9000 (and QS9000 in the automotive industry) is being used by some customer companies as a process compliance model. Other companies encourage suppliers to consider high-performance, continuous improvement models like the Malcolm Baldrige National Quality Award

Many small and medium size firms have developed their own supplier evaluation, selection, and certification processes. These generally reflect a mixture of generic process reviews combined with specific process elements that fit the particular needs of the customer company. Most also include some basic review of the supplier's financial and general management strengths.

Some large firms have developed very extensive supplier assessment and development programs. Dedicated staff maintains and develops the assessment and improvement tools and carries out extensive on-site visits with suppliers. Suppliers move through several steps or phases on a path to becoming a "preferred" or "strategic partner" supplier.

Clearly, suppliers learn something achieving ISO9000 registration. And, the assessment and audit procedures applied by many customers can provide useful inputs to a supplier's focus. However, ISO9000 or customer-driven audit and assessment practices do not connect clearly to specific measurable improvements for the customer in the four key business drivers (total cost, quality, market responsiveness, and technology).

Many companies use their supplier performance metrics as directive tools to induce suppliers to improve performance. Certainly, the regular sharing by customers of supplier performance metrics covering on time delivery, incoming and in process quality, and, increasingly, flexibility/respondiveness, with their suppliers is becoming more widespread. However, this approach is not built on an improvement process that can lead to optimal solutions. For example, on time delivery problems might lead the supplier to simply increase inventory buffers at the finished goods, WIP, or raw material level when there are more productive solutions elsewhere

Other efforts by customer firms are more targeted in their approach to changing supplier behavior. Examples of these include demands for statistical process control data, lot traceability, bar coding, electronic commerce, engineering data file transfers, fax and electronic kanbans and others.

All of these directive or compliance based approaches to supplier performance improvement share certain common failings that result from the fact that they are, for the most part, inherently generic. And, more importantly, they do not create an improvement process that is clearly aligned to specific, measurable objectives focused on customer needs. In an environment in which lean manufacturing practices are producing order of magnitude improvements in lead times, cycle times, inventory levels, quality, and flexibility, the results of the compliance or directive approach are too diffuse (as suggested for ISO9000 case) or too tactical because they are isolated changes (e.g. bar coding).

Part Two of this article in the next issue of ConnectionS will discuss: (1)barriers to supplier development within the customer company and within suppliers; and (2) new approaches to integrated, process oriented supplier development.

6.2.6. Lean implementation

Creating awareness and understanding of lean manufacturing practices at the shop floor level was NESI's starting point in workshop development and deployment. After conducting more than thirty workshops on a range of lean practices, a number of conclusions can be drawn about the process that moves a company from awareness to actual implementation.

Lean manufacturing requires a paradigmatic break from conventional manufacturing theory and practice, therefore the role of senior management is central. Even shop floor implementation of tasks as simple as team-based set-up reduction can not be effectively carried out without senior management support through policy and resources. NESI has maintained a strong message that lean methods produce order of magnitude improvements in fundamental business performance. Building and demonstrating this business case for senior management was carried out through workshops, presentations, and benchmarking opportunities.

In repeated cases, we have seen personnel from a company attend a workshop and then, at a following workshop, other personnel attend. This is typically followed by discussions between a senior manager and NESI staff and consultants. At this point the company has five or six people who have attended workshops and become convinced, or buoyed in their conviction, that lean manufacturing is a must for them.

The company is now ready for a visit by NESI staff to begin assessing their readiness to undertake a project and a rough order-of-magnitude scope of the work. This is typically accomplished in a three to four hour visit. This includes a meeting with the prospective team from the company, a plant tour, and an open discussion about what NESI staff and consultants see to be the opportunities and issues. This session is followed up with a formal proposal to the company defining the scope, objectives, approach, deliverables, and commitments required of the company.

All of the implementation projects have a typical shape. A team or teams of company personnel are formed to work on the project. In general one person is chosen to have a two- to three-day a week responsibility in the project. Other team members work on an as needed basis. This shapes the work to respect the ongoing business requirements of the company. The teams usually work on set-up reduction, pilot flow manufacturing with or without cell design, and purchasing/supplier issues to support the flow manufacturing pilot. Lean education is provided to a broad range of company personnel through day long

and shorter on-site training. Implementation times for the pilot area typically are three to six months.

An alternative path between workshop attendance and a fully scoped proposal for work is a two or three day on-site visit by consultants. This allows the consultants to become quite familiar with the company's operations and culture. The last day is used for a full-day on-site training event that is customized to the company. This process builds both internal support for the project and firmly establishes the consultant's credibility.

The entire cycle of time from the company first sending personnel to a workshop and starting an implementation project has typically been six to twelve months.

6.3. Organizational development and sustainment

6.3.1. Industry involvement and support

NESI was fortunate to have a pre-existing group of industry stakeholders when the ADPP project began. They participated in the hiring of NESI's Executive Director and drove early program development through frequent meetings of the Steering Committee. This provided NESI staff with a constant stream of program input and a regular check on developments.

There were a number of recurring issues in dealing with this strong industry input:

First, the regional nature of NESI's work made representation by geographically diverse companies very desirable. However, the capacity of companies to provide representation at Steering Committee meetings was practically limited to a radius of 60—90 miles around Boston. This was driven by both the concentration of companies within this belt and the fact that companies from, for instance, Burlington, Vermont (a large center of manufacturing in that state) would have to devote more than a day to attend a Steering Committee meeting. On occasions teleconferencing provided some relief for this geographic problem.

In the first two years of the project local state steering committees were organized in New Hampshire, Massachusetts, and Maine. This was part of NESI's original state partnering model. None of these developed a long-term life of their own. This is a result of the fact that all substantial policy issues were resolved centrally by the NESI Steering Committee and the staff. Additionally, the mass of the program in each state was too small to sustain industry involvement. Finally, the program objective of state partnerships was found to be unproductive (see 6.1.4 above).

A second recurring issue was that the Steering Committee was not sufficiently knowledgeable or experienced in state and federal public program administration to provide NESI staff with guidance or useful advice. Ultimately, it

became clear that the Steering Committee should be focused mainly on program content and direction. These are areas where they can add valuable insight. In other areas of concern to the program, like governmental and host organization relations, NESI staff kept the committee informed, but did not seek active engagement.

Third, there was a constant tension between the needs of the large companies and the small companies on the Steering Committee. Although this was not a crippling problem, it is probably inevitable when the large firms have sales of \$600 million to \$3 billion and the smaller firms are below \$10 million in sales. This was frequently revealed in discussions around pricing or workshops and the programmatic focus of workshops and implementation work.

In summary, the Steering Committee and other forms of industry input to NESI's programmatic direction proved invaluable to the staff and the program overall. The consistent support and participation of industry representatives provided corrective nudges to direction and added credibility and substance to NESI's work.

6.3.2. Developing internal value

For most government funded programs engaged with manufacturing the operational model is that of a resource broker. MMP and BSMN, the programs closest to NESI, both fit into this operational model. They provide companies with some assessment and technical services, but the vast majority of their value to companies is delivered in the form of third party consultants retained to perform projects.

NESI decided early in the project that it would be important to build some central internal areas of competence. This would provide NESI with real credibility with its manufacturing clients as more than a mere broker of services and improve the financial leverage of the project. The work on SCM became a centerpiece of this strategy to develop internal capacity and knowledge. It was decided that shop floor lean manufacturing practices was rapidly becoming a commodity consulting field and that NESI could not sustain the personnel required to demonstrate a true competence in this field.

This strategy of focusing on internal value generation has produced good results for NESI. NESI staff are recognized as valuable resources in the areas of lean manufacturing, supply chain management, and advanced purchasing practices. The development of the *SCM System Framework* and the *SCMI Process* have provided NESI with a leading edge position in an important area of organizational and business development.

6.3.3. Professional organizations

As marketing venues and sources of program content and credibility, professional organizations within the manufacturing world are a valuable asset. During the life of the program NESI had direct contact with local and regional chapters of APICS, ASQ, AME, AQP, Massachusetts Council for Quality, NAPM (especially

the Boston and Vermont chapters). NESI staff made numerous presentations to various elements of these organizations.

The most productive relationship was developed with the Northeast Region of AME. Five, jointly-sponsored workshops were held, chiefly on visual systems and SCM topics. NESI and AME shared a common marketing strategy of public workshops and a substantial overlap in programmatic focus on lean manufacturing and lean enterprise topics.

6.3.4. Staffing

The hiring of the Executive Director for NESI was conducted jointly by the staff of BSSC and the Steering Committee. All candidates were interviewed by the Steering Committee and committee input into the final choice was significant. A key element in the staffing of NESI has been a focus on finding people with a broad base of experience in manufacturing. This was important for building the credibility of the program with industrial stakeholders and clients.

However, the lack of substantial experience by NESI staff in government-based programs proved to be a considerable shortcoming, especially during the first year of the project when considerable outreach to government organizations in the New England states was required. The lack of understanding of government's overall organizational culture made this process less efficient. Fortunately, as the project matured this shortcoming became less important.

6.3.5. Host Organizations

Both BSSC and now CBWL have very significant interest in and capacity for workforce development. But this mission, focusing primarily on unemployed, underemployed, and dislocated individuals does not translate readily to firm-centered programs like NESI. Neither organization, in practice, has had work with manufacturing firms as a core value or practice of their organizational mission. Many of their internal administrative functions were not well suited by design and in practice to supporting firm level work, especially fee-based consulting with multiple streams of revenue and complex job-tracking and job-costing requirements.

Despite the apparent and real mismatches in mission and administrative requirements, the fact of the matter is that NESI was provided with the essentials of a program home. Under the pilot project structure, NESI staff was provided with significant opportunities to make mistakes, grow, adapt, and create a program outcome with a maximum of industry stakeholder input, market challenges, and a minimum of oversight. In the final analysis, this may be the most significant, and rarest, contribution that a host organization could make to a project like NESI.

It should also be noted that NESI staff made real contributions to both host organizations. NESI arranged for the organizations' contracts with suppliers for rental cars, credit card transactions, printing, mailing services, and other support services at competitive rates. All Boston-based NESI staff worked on host

organization task committees during the merger process. In addition, BSSC and CBWL staff attended NESI workshops on purchasing skills.

6.3.6. AF Mantech support

The program management involvement by AF Mantech has been consistently positive. Program Manager Wally Patterson and other AF Mantech personnel maintained a regular interchange with NESI staff and industry stakeholders. This provided NESI with innumerable contacts, leads, suggestions, critical reviews, and referrals. AF Mantech staff attended NESI workshops and conferences. Visits were made to NESI member companies.

Over time, the programmatic connection between NESI and AF Mantech grew. As NESI, driven by its industry stakeholders, evolved to its focus on lean manufacturing and SCM, connections with AF Mantech's interests in the same topics became quite strong. This manifested itself in very specific and concrete ways that broadened NESI's exposure in the manufacturing community and added content value.

With AF Mantech support, NESI made an early and increasingly useful connection with the Lean Aerospace Initiative (LAI) at MIT. This communication and involvement with the LAI's Supplier Relations subgroup, as well as to the Lean Enterprise Model as a whole, added to the depth of NESI's understanding and connection to lean and SCM thinking. NESI was also invited to attend and participate in LAI activities..

AF Mantech created a Focused Study Team for Supplier Development and Management during 1996-97. NESI made a presentation to this team on its work in developing the *SCMI Process* and the *SCM Framework* business model. In addition, during September 1996, NESI organized a visit by members of this team to visit and study SCM practices at a number of firms in the New England area. NESI staff also reviewed and commented on the team's final report of findings and recommendations.

6.3.7. Is NESI Sustainable without Government Support?

NESI has developed a very sound niche market position as a respected provider of lean manufacturing and supply chain management services. The overall market for these services is expanding and there are few serious competitors for customers at the bottom end of the size range among SMEs.

Given the following variables: (1) a target market of SMEs, particularly focusing on the small manufacturers (fewer than 50 employees), (2) a program focused on lean manufacturing implementation and supply chain management performance improvement, and, (3) a broad geography with uneven distribution of target customers, is NESI sustainable? This question has been posed throughout the NESI's life. The answer is "yes", but the conditions underlying this answer are complex and interesting.

First, the gross margin for lean manufacturing awareness and implementation (revenue from implementation projects, training events, or other

sources less direct workshop and project costs) is negative¹⁴. The sales process, bringing a company from first contact through lean implementation project start, requires 9 months to one year and four to five sales contacts. These contacts must be high content, high level events, like workshops or onsite visits, with technically credible personnel readily available.

The consulting resources required to carry out lean implementation projects are now commanding \$1,500 to \$2,000 per day. Additionally, these external resources are in very high demand by medium and large companies. Therefore, from their perspective, they see very little reason to reduce their fees, even in light of the acknowledged marketing costs of creating the consulting opportunities at the smaller firms.

On the other side of the equation, given the very limited financial capacity of SMEs to support \$30,000 to \$50,000 cash outlays (the typical cost of a lean implementation project), it is not possible to leverage these resources by charging higher fees by more than 10-15%.

Both of these factors mean that NESI can not generate sufficient gross margins from lean implementation projects to sustain the organization.

As an alternative strategy, if NESI could hire lean implementation consultants directly, it is possible that the overall leverage could be significantly improved. However, given the structure of publicly funded programs, it is not feasible to hire these resources directly since the pay scales would not fit within the program host organization. Given the spread of lean implementation, there would be ongoing problems retaining experienced consultants because of the draw of large consulting organizations and higher salaries.

Shifting the focus from lean awareness and implementation to supply chain management services changes this picture. First, the demand for these services is predominantly from medium and large firms. Second, NESI has developed its own intellectual property and internal expertise to deliver these services. This means that our ability to achieve reasonable gross margins on project revenues is good. The task immediately ahead is to expand the revenue stream from supply chain management projects.

In summary then, NESI staff believes the organization is sustainable. However, without some government inputs, there will be considerable ongoing pressures to focus the organization's marketing, service development, and service delivery toward the upper end of small enterprises and to greatly increase the importance of medium and large firms in NESI's customer mix. The current plan of action is to seek ongoing government support as a portion of NESI's revenue stream.

¹⁴ If market-rate prices were charged for workshops the gross margin would improve but it is doubtful that the smaller end of the SME market would continue to attend.

7. Recommendations for Future Support for SME Performance Improvement

The purpose of this section is to discuss recommendations for future action by both government and industry to improve the performance of SMEs.

There is considerable evidence that the aggregate performance of US SMEs continues to lag behind both large US manufacturers and SMEs in competitor nations, especially Japan and Germany. The NIST MEP system is built largely on the premise that not only does a SME performance gap exist but that there is a market failure to produce sufficient affordable consulting and technical resources appropriately located and accessible to US SMEs.

At the firm level, large manufacturers in NESI's geographic territory have consistently expressed and acted on a desire to improve the performance of their supply base. Some have had active self-funded supplier development programs for a number of years. The national press has reported on other large manufacturers developing similar supplier development programs, particularly in the automotive industry.

And, AF Mantech has consistently acted on the premise that there is a significant opportunity to improve the overall performance of the aerospace manufacturing community by focusing improvement efforts on SMEs.

Our question here is, based on NESI's experiences over the past four years, what public and private policies should be pursued?

7.1. Barriers to SME Performance Improvement – Defining the Problems

Although NESI has observed shortcomings in the supply of accessible and affordable technical and consulting resources for SMEs in New England, we do not believe this is the root cause of poor SME performance. Broadly, the barriers to the improvement of the performance of SMEs fall under the following banners:

- Senior management and/or ownership understanding of and commitment to change for high-performance
- Lack of awareness, knowledge, and skills in high-performance organizational methods and practices, especially lean manufacturing
- Lack of well-established and effective models and processes for collaborative customer-supplier work
- Underdeveloped or insufficient human resources from ownership and senior management to the shop floor

In addition, there are at least two other barriers that clearly influence SME performance improvement. However, they are outside the scope of our discussion here.

- Lack of capital and other financial resources

- Lack of technical knowledge and skills in materials, material processing, engineering design, and others

Senior management/ownership understanding and commitment is absolutely central to real change in SME performance. Very little can or will occur without their direct involvement. Although technical knowledge and skills in materials, materials processing, and engineering are extremely important, NESI's experiences, and those of others, clearly demonstrate that implementing lean manufacturing produces order-of-magnitude gains in performance. Lean manufacturing is a first priority strategy for SMEs. No other approach will produce so much improvement in cost, quality, and market responsiveness with so little capital investment.

However, optimizing individual firm performance can not be achieved without placing the firm in the context of its roles in the various supply chains in which it exists. Choices of the most appropriate methods inside a company are dependent on its role in the supply chain. And, many of the most significant savings and improvement in performance can only be achieved through a collaborative approach capturing the customer and key supplier inputs. This supply chain system view leads to a need for better models and processes that can sustain collaborative work between customers and their key suppliers.

7.2. Government Funded Roles

As a preface to these remarks, we should note that NESI staff is aware that AF ManTech, LAI, and the Aerospace sector has its own structural and cultural issues driven by government contracting requirements and history. These clearly impact the issues of improving SME performance and the performance of the sector as a whole. However, NESI staff is insufficiently experienced and knowledgeable of these factors to make useful and reliable comments about them. Nevertheless, we believe that our experiences as a government funded project working predominantly in commercial manufacturing sectors are applicable and valuable.

Although the tasks described by the recommendations below are discrete project elements, they in fact readily fit into a more general strategy for increasing the deployment of the larger lean enterprise model described by LAI's Lean Enterprise Model and summarized by books such as Womack and Jones, Lean Thinking. It is our explicit intent here to focus on the deployment of lean practices that are becoming more broadly accepted in high-performance companies and industry sectors.

7.2.1. Third Party Support for the Transformation Process

NESI's experiences strongly support the need for engaged, technically competent organizations to build awareness and provide technical support to the development of lean manufacturing implementation projects. The roles for these organizations include using a range of techniques to create awareness and an impetus for change among the senior managers and owners of SMEs. Once management is engaged, the other primary role is to help firms develop the scope and approach for an implementation project and identify and select an appropriate consulting resource to support the project. To accomplish these tasks the third part

organization and its staff must be perceived by the SMEs as knowledgeable manufacturing professionals.

7.2.2. Lean Awareness and Skill Development

NESI's work has shown the need and value of public workshops, on-site custom workshops, and other awareness and skill building tactics for SMEs. For the purposes of the aerospace community, the focus of this awareness building can be expanded from NESI's current focus to include more topics on lean product development since this is such an important component of the aerospace industry's total cost structure. To add depth, workshops should be offered at an intermediate level to expand the practical applications of lean manufacturing into cell design, multi-model flow manufacturing, set up reduction, and others.

This awareness and skill building work should be built on the same principles that have evolved in NESI's work to date. A strong business case should underlie the program leading to training that is focused on actionable practical information. Where useful, opportunities for benchmarking and role model visits can reinforce the workshops.

Finally, very few companies have successfully launched a lean manufacturing program without some expert outside advice and coaching. It is important that companies have access to proven consulting resources. As it is not practical for multiple reasons to develop a list of "approved" consultants, a first step in helping companies to find the required consulting resources is the development of an evaluation guide to selecting lean consultants. This template of criteria would provide companies embarking on a search for consultants with a practical checklist of consultant attributes. This will improve and simplify the search.

OEMs can support the awareness building program through direct financial support and/or, if they have significant real accomplishments in implementing lean methods, they can act as role models and provide consulting support and referrals. Our experience to date strongly suggests that SMEs implement lean practices on the shop floor for their own strategic business purposes. They make financial and performance gains that are largely internalized and not dependent on an individual customer for sustainment.

Based on NESI's work and experience over the past four years, a national awareness campaign can be launched immediately with full deployment over a year's time. This awareness campaign might have a useful life of two to three years.

7.2.3. Business Partnering Relationship Models

As gains are made on the shop floor through the application of lean manufacturing methods, the largest opportunities for improving the overall performance of any supply chain are to be found in the ability of the supply chain, lead by the OEM, to address new product development, cycle time, and total cost issues at the supply chain system level.

However, this can only be accomplished in an environment in which a supply chain can act with some coherence over a fairly long period of time¹⁵. This means that the OEMs, as leaders of their supply chain, must address the issues discussed in *6.2.4 Leverage of Large Companies with Their Suppliers*. OEMs need to develop business relationships with their suppliers that address fundamental issues of the rules of engagement between customer and supplier. In particular, longer term relationships that provide for reasonable gainsharing and a stable environment are critical.

Within the commercial sectors of the economy we expect OEMs to increasingly develop business relationships with their high value-added key suppliers that will support the kind of long-term collaborative practices that will produce large improvements in supply chain performance.

In the aerospace sector, the importance of the US government as the customer and its contractual relationships with the OEMs calls for a different approach. Here work must be done by the government to alter the business environment to create expectations for the OEMs to build long term relationships in which gainsharing can exist. As noted above, this is not an area in which NESI can make a useful contribution, so we close this section with just the note that building new business relationship models is critical to engaging the whole supply chain in effective new modes of collaborative practices.

7.2.4. Building Collaborative Practices – The Future of the Supply Chain

Lead by the example of the automotive sector, manufacturers are expanding and adapting the lessons of supply chain relations to capture the energies and talents of many levels of the supply chain. These practices build on the Toyota Production System experiences and are creating new models based on corporate relations in the US and Europe.

Government funded pilot projects within the aerospace sector can focus on developing the skills and practices between OEMs and one or more tiers of their supply base. This would include the development of appropriate business relationship models, internal policies and procedures within the OEM, and deployment of various collaborative techniques involving the OEM and suppliers.

To develop the environment and provide common training, external consulting resources should be a component of these pilots. This will aid in the vital step of pushing the project forward across interdepartmental boundaries within the OEM. In addition, the consultants will act as communicators and mediators during the inevitable process of resolving multi-dimensional problems across one or more corporate boundaries between the OEM and the supply chain.

¹⁵ The question of the life span for significant key supplier relations within a supply chain is determined by factors like product development cycle times, product life cycles, and rate of technology change within the subject industry sector.

7.2.5. Developing OEM Supply Chain Management Competence

A central finding of NESI's work has been that the role of the customer in customer-supplier relationship, and more generally in the supply chain, is critical. Improving the performance of suppliers and the supply chain is not simply an issue of "fixing" the suppliers. The development within OEMs of a well-integrated, cross-functional system to manage and work with suppliers and the supply chain is at the center of the problems and the opportunities.

Government funded pilot projects to assess, improve, and develop Supply Chain Management Systems within divisions or plants of OEMs in the aerospace sector would deploy the practices and tactics that have already emerged as proven in the commercial sector and develop new practices appropriate to the aerospace environment. NESI's *SCMI Process* and *SCM Pathways* would provide excellent business development models, assessment processes, and implementation methods for these pilots.

These pilot SCM system development projects should relate to both the ongoing production activities and new product development. The SMEs who are part of the supply chain for the OEMs will benefit directly from more reliable information and better communication.

8. Appendices

8.1. Steering Committee Members

NESI Steering Committee Members		
Name and Title	Company and Location	Tenure
Robert Fulford, Purchasing and Supply Chain manager	Varian Ion Implant Systems, Inc., Gloucester MA	1992 to present
Ron Pariseau, Corporate Director of Purchasing	The Foxboro Company, Foxboro, MA	1992 - 1994
John Rabbit, Director of Quality	The Foxboro Company, Foxboro, MA	1992 - 1996
Mohamed Haddadi, Corporate Director of Purchasing	The Foxboro Company, Foxboro, MA	1996-1997
Charles Chappell, Materials and Supply Chain Manager	Helix Technology Corp., Mansfield, MA	1997 to present
Peter Novello, President	Alphatron Manufacturing, Inc., Ward Hill, MA	1992 to present
David E. Miller, President	Lemco Miller Company	1992 to present
Paula Gauthier, Director of Materials	Kronos, Inc., Billerica, MA	1997 to present
Tom Michaels, Director of Purchasing	OSRAM Sylvania, Hillsboro, NH	1996 to present
Sandy Roberts, Director	Center for Business and Industry, Northern Essex Community College, Haverhill, MA	1992 to 1998
Brian Bosworth, Principal	Regional Technology Strategies, Cambridge, MA	1992-1996
Ed Davis, VP & GM	Greene Rubber Co., Inc.	1997 to present

8.2. Selected Bibliography

Selected Bibliography		
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Galsworth, Gwendolyn D.	<u>Visual Systems: harnessing the power of a visual workplace</u>	NY: AMACOM, 1997
Goldratt, Eliyahu M.	<u>The Goal</u> , 2 nd revised edition	Great Barrington, MA: North River Press, 1992
Gordon, Sherry R.	“Changing the Structure of Business”	<i>APICS – The Performance Advantage</i>
Gordon, Sherry R.	<u>Improving Company Performance Through Supply Chain Management Practices</u>	Forthcoming (1999) from Lionheart Publications
Hines, Peter	<u>Creating World Class Suppliers: Unlocking Mutual Competitive Advantage</u>	London: Pitman Publishing, 1994
Imai, Masaaki	<u>Kaizen: The Key to Japan’s Competitive Success</u>	NY: McGraw-Hill, 1986
Imai, Masaaki	<u>Gemba Kaizen: a commonsense, low-cost approach to management</u>	NY: McGraw-Hill, 1997
Morgan, Jim	“Cure your own faults before tackling supplier management”	<i>Purchasing</i> , 7/17/97
Suzaki, Kiyoshi	<u>The New Manufacturing Challenge: techniques for continuous improvement</u>	NY: The FreePress, 1987
Tonkin, Lea A. P.	“Greene Rubber: Persistence, Patience, and Change”	<i>Target</i> , Vol. 13 No. 4 Magazine of AME
Womack, James P. and Daniel T. Jones	<u>Lean Thinking</u>	NY: SIMON & SCHUSTER, 1996
Womack, James P., Daniel T. Jones, and Daniel Roos	<u>The Machine That Changed The World: the story of lean production</u>	NY: Harper Perennial, 1990

8.3. Glossary of Acronyms and Other Terms

<u>Acronym or Term</u>	<u>Definition or explanation</u>
APICS	American Production and Inventory Control Society – the professional organization for materials and planning professionals. APICS chapters in Boston, Worcester, Merrimack Valley, and Maine are particularly active in New England
AQP	Association for Quality and Participation
ASQ and ASQC	American Society for Quality, formerly the American Society for Quality Control – the professional organization for quality professionals. Active chapters in Boston and Rhode Island
Barcodeing	The use of standardized graphical symbols that are machine readable. Now commonly seen in consumer labels for Universal Product Codes.
BASE Council	Boston Area Semiconductor Equipment Council – formerly TQMBase Council - an industry organization that provides technical and other training and networking opportunities for member companies.
BSSC	Bay State Skills Corporation. A quasi-public corporation of the Commonwealth of Massachusetts. Original host organization for NESI. Merged with ISP to form CBWL in 7/97.
CBWL	Corporation for Business, Work, and Learning. A quasi-public corporation of the Commonwealth of Massachusetts. Current host organization for NESI.
ConnSTEP	Connecticut State Technology Extension Partnership. A NIST MEP affiliate.
DOC	Department of Commerce. A department of the US Federal government. See NIST and MEP
EDI	Electronic Data Interchange – more broadly used along with EC (Electronic Commerce) for the practices of communicating business and technical information by electronic means between firms.
ISO9000	An international standard for process and quality systems
ISP	Industrial Services Program. A quasi-public corporation of the Commonwealth of Massachusetts. Merged with BSSC to form CBWL in 7/97
Kaizen, Kaizen blitz	Kaizen is a Japanese word that means continuous improvement. See books by Imai in the Selected Bibliography. Kaizen blitz is a short event (1 to 5 days) that involves teams in solving problems and implementing solutions. Kaizen is also used as a verb meaning to apply the tools and techniques of kaizen to a situation or problem. "Let's kaizen this set up"
LAI	Lean Aerospace Initiative. A consortium of aerospace OEM's government, and MIT that studies lean practices in this industry
Lean, Lean Enterprise Lean Manufacturing Lean manufacturing	Throughout this report the terms "lean", "lean enterprise" "lean manufacturing" and "lean manufacturing practices and methods" is used to refer to a body of business concepts and processes that have evolved over the last twenty years in the US. These concepts and practices are built largely on the work of Toyota, currently embodied as the Toyota Production System. A central American contribution that NESI and manufacturers throughout New England have

methods	begun to integrate into "lean thinking" is the work of Eliyahu Goldratt on the Theory of Constraints. Lean has become less identified as a purely shop-floor body of knowledge and is now more broadly seen as applying to the extended enterprise encompassing the entire supply chain from raw materials to the end customer. Thus, lean includes practices like Just In Time Manufacturing (JIT), Demand Flow Technology (DFT), Synchronous Flow Manufacturing, and Continuous Improvement to mention a few of the important subordinate terms. For readers unfamiliar with lean please refer to the Selected Bibliography and the citations for Goldratt, Suzuki, and Womack.
Maine Market Development Center	Host organization for NESI's staff person Kate Krukowski from 1996-1997
Massachusetts Council for Quality	The MA-based non-profit group working with the Malcolm Baldrige National Quality Award Criteria. Performs training of auditors, self-assessments for companies, and formal assessments for state-level quality awards
MEP	Manufacturing Extension Partnership. A national system of manufacturing extension offices offering technical and management consulting services to SMEs. A NIST program
MIT	Massachusetts Institute of Technology. Home of the LAI and other lean manufacturing oriented projects.
MMP	Massachusetts Manufacturing Partnership. A NIST MEP affiliate.
NAPM	National Association of Purchasing Managers – the largest professional organization for purchasing professionals. The Boston and Vermont chapters are particularly active sites in New England
NHMEP	New Hampshire Manufacturing Extension Partnership. A NIST MEP affiliate.
NIST	National Institute for Standards and Technology. Part of the Department of Commerce. Parent organization for MEP and Malcolm Baldrige National Quality Award
RIMES	Rhode Island Manufacturing Extension Service. A NIST MEP affiliate.
SBM	Supply Base Management. Phrase used to describe an integrated system of business practices employed to manage and work with a firm's suppliers. See <i>SCM</i>
SCM	Supply Chain Management. See <i>Supply Chain</i> and Footnote 2
SME	Small and Medium Size Enterprise. Formally described as a firm with 500 or fewer employees. May be a profit center of a larger firm. Generally the target audience for MEP centers.
SPACE	Springfield Area Coalition for Excellence – A Springfield, MA-based membership organization that provides training and other services to companies in continuous improvement, team-based work, and more recently lean manufacturing topics
SPC	Statistical Process Control
TQMBase Council	See BASE Council
Visual Systems	An American adaptation of the Japanese "5S"(See Suzuki in the Selected Bibliography) approach to industrial housekeeping and visual order. Visual systems strengthens the traditional approach with much more clarity around the use of visual cues, signs, symbols, controls, etc. to make the workplace more

	transparent and self-ordering and controlling. See Gwen Galsworth in the Selected Bibliography for a comprehensive presentation of this.
VMEC	Vermont Manufacturing Extension Center. A NIST MEP affiliate.